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EVERYDAY ARITHMETIC

A Practical Mental Arithmetic

BY

JOHN B. GIFFORD

AUTHOR OF "ELEMENTARY LESSONS IN PHYSICS"

BOSTON
LITTLE, BROWN, AND COMPANY
1919

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Lena Malone

PREFACE

This book has been prepared in response to the demand for a one-book course in mental arithmetic topically arranged, and dealing with such subjects and furnishing such problems as are met with in every-day life. "In doing the world's work the tradesman, the man in the shop, and people in almost all walks in life use much more mental than written arithmetic." More and more those responsible for the training of the workers are coming to realize this fact, and are devoting more of the arithmetic time in schools to mental work.

All subjects taken up in written arithmetics are treated in this book. Both development and practice work are included. The subjects are arranged in a logical order, and many carefully graded exercises given in each.

The last twenty-four pages consist of miscellaneous review problems. In most systems of schools these would be suited for pupils in the last year of arithmetic work, and a considerable portion of them might be used earlier.

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MEASURES

LENGTH

12 inches (in.) = **1 foot** (ft.)
3 feet = **1 yard** (yd.)
16½ feet, or **5½ yards** = **1 rod** (rd.)
320 rods or **5280 feet** = **1 mile** (mi.)

A hand is 4 inches, and is used in measuring the height of horses and cattle.

A fathom is 6 feet, and is used in measuring the depth of the sea.

A pace is generally considered 3 feet, and is used in measuring distances by steps.

A chain is 4 rods, or 66 feet, and is used in measuring land.

A knot is a nautical, or geographical mile, and equals 1.15 common miles. It is used for measuring distances upon the sea.

A league is 3 miles. Upon the sea it is 3 nautical miles; upon the land, 3 common miles.

SURFACE

144 square inches (sq. in.) = **1 square foot** (sq. ft.)
9 square feet = **1 square yard** (sq. yd.)
30¼ square yards }
272¼ square feet } = **1 square rod** (sq. rd.)
160 square rods = **1 acre** (A.)
640 acres = **1 square mile** (sq. mi.), **or section**

36 square miles = **1 township** (tp.)
100 square feet = **1 square** (in roofs, floors, etc.)

VOLUME

a. *Cubic Measure*

1728 cubic inches (cu. in.) = **1 cubic foot** (cu. ft.)
27 cubic feet = **1 cubic yard** (cu. yd.)

b. *Wood Measure*

16 cubic feet = **1 cord foot** (cd. ft.)
8 cord feet = **1 cord** (cd.)

c. *Liquid Measure*

4 gills (gi.) = **1 pint** (pt.)
2 pints = **1 quart** (qt.)
4 quarts = **1 gallon** (gal.)

d. *Dry Measure*

2 pints = **1 quart**
8 quarts = **1 peck** (pk.)
4 pecks = **1 bushel** (bu.)

1 gallon = 231 cubic inches
7½ gallons (nearly) = 1 cubic foot
1 cupful = about 1 half pint

In measuring grains the measures should be even full.

In measuring fruits and vegetables the measures should be heaped.

An even bushel equals about 1¼ cubic feet, a heaped bushel about 1½ cubic feet.

AVOIRDUPOIS WEIGHT

16 ounces (oz.) = **1 pound** (lb.)
2000 pounds = **1 ton** (T.)
2240 pounds = **1 long ton**

The long ton is used in selling coal at wholesale and computing duties.
60 pounds of wheat or potatoes = 1 bushel
56 pounds of corn or rye = 1 bushel
32 pounds of oats = 1 bushel
196 pounds of flour = 1 barrel
200 pounds of beef or pork = 1 barrel
A ton of coal occupies about 35 cubic feet.
A cubic foot of air weighs about 1 ounce.
A cubic foot of water weighs about 1000 ounces, or 62½ pounds.

TIME

60 seconds (sec.) = 1 minute (min.)
60 minutes = 1 hour (h.)
24 hours = 1 day (d.)
7 days = 1 week (wk.)
30 days = 1 month (m.)
4 weeks = 1 school month
365 days = 1 (common) year (yr.)
366 days = 1 leap year
10 years = 1 decade
100 years = 1 century

CIRCULAR MEASURE

60 seconds = 1 minute
60 minutes = 1 degree (°)
360 degrees = 1 circumference

1 degree of longitude at the equator = 60 geographical miles, or about 69⅙ common miles.

GROUPS OF UNITS FOR COUNTING

12 units = 1 dozen (doz.)
12 dozen = 1 gross (gro.)
12 gross = 1 great gross
20 units = 1 score
24 sheets = 1 quire
20 quires (480 sheets) = 1 ream

In the paper trade of the United States the ream now commonly contains 500 sheets. The quire corresponding to this ream contains 25 sheets.

EVERY-DAY ARITHMETIC

A PRACTICAL MENTAL ARITHMETIC

Write No Answers in This Book

ADDITION — SUBTRACTION

Twos

1. *During three minutes think rapidly these additions and subtractions:*

7	4	9	6	3	8	5	2	12	11
+ 2	2	2	2	2	2	2	2	2	2
4	9	12	5	8	11	7	13	6	10
− 2	2	2	2	2	2	2	2	2	2

To the Teacher: If these exercises are taken as class work, the following method of proceeding is suggested.

2. At a signal from the teacher write the answers by lines with a pen on a slip of paper. As you finish, stand quietly in good position in the aisle at your left.

The teacher may notice how many complete the writing within a minute.

3. Let one pupil read his answers aloud. Others check their correct answers.

4. How many of your answers are correct?

5. Drill upon the parts not answered correctly until you can think each answer as soon as you see the figures.

Liquid Measure

2 pints (pt.) = 1 quart (qt.)
4 quarts = 1 gallon (gal.)

The old meaning of *quart* is *quarter*. A quart is a quarter of what?

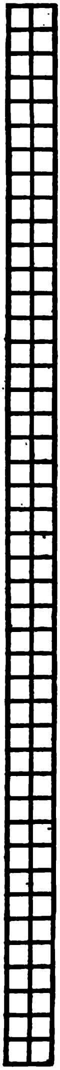
6. 1 qt. + 3 pt. = x pints

x means *how many?*
1 quart = x pints   2 pints + 3 pints = x pints

An exercise or question in small type is intended to help in the one before it, and no answer to it need be written.

In each of these exercises think the quart as 2 pints:

7. 1 quart + 7 pints = x pints   1 quart + 2 pints = x pints
8. 1 quart + 8 pints = x pints   1 quart + 4 pints = x pints
9. 1 quart + 9 pints = x pints   1 quart + 5 pints = x pints
10. 1 quart + 6 pints = x pints   1 quart + 10 pints = x pints
11. 6 pints − 1 quart = x pints   10 pints + 1 quart = x pints
12. 3 pints − 1 quart = x pints   5 pints − 1 quart = x pints
13. 8 pints − 1 quart = x pints   10 pints − 1 quart = x pints
14. 4 pints − 1 quart = x pints   7 pints − 1 quart = x pints
15. 9 pints − 1 quart = x pints   11 pints − 1 quart = x pints
16. 11 pints − 1 quart = x pints   13 pints − 1 quart = x pints
17. 14 pints − 1 quart = x pints   17 pints − 1 quart = x pints



To the Teacher: **Exercises starred are intended for the more rapid workers. They average more difficult than the others, and generally deal with different subjects.**

18.* 5 pt. − 1 qt. = x pints   12 pt. − 1 qt. = x pints
19.* 4 pt. + 2 qt. = x pints   10 pt. − 3 qt. = x quarts
20.* 9 pt. + 2 qt. = x pints   8 pt. + 5 qt. = x quarts

Counting by Twos — Odd and Even Numbers

21. Beginning with 2, count the squares at the left by 2's (two at a time). Count them backward by 2's.

22. Write the forward counts (numbers named in counting) with figures.

23. Which of these numbers named can be divided by two without a remainder?

Such numbers are **even numbers.**

24. Write 5 even numbers larger than those named.

25. Beginning with 1, count the squares at the right by 2's. How many squares are there?

26. Write these forward counts with figures.

27. Which of these numbers can be divided by 2 without remainder?

Such numbers as these are **odd numbers.**

28. Write 5 odd numbers larger than those named.

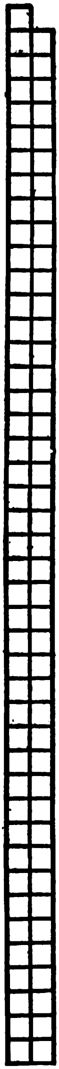
29. Write 4 even numbers larger than those named.

30. From a 2-quart jar of milk 3 pints were used; how much was left?

31. 1 gallon − 3 quarts 1 pint = x.

32. 1 gallon − 3 pints = x.

33.* $2\frac{1}{2}$ qt. = x pints   5 qt. + 3 pt. = x pints
34.* 5 qt. − 3 pt. = x pints   6 qt. − 5 pt. = x pints
35.* 3 qt. + 3 pt. = x pints   12 qt. − 4 pt. = x pints
36.* 2 qt. − 3 pt. = x pints   3 qt. − 5 pt. = x pints
37.* 7 qt. + 6 pt. = x pints   2 qt. + 3 pt. = x pints



38. *Think rapidly the addition and subtraction of the following numbers as on page* 1:

24	27	25	28	23	21	29	26	22
+ 2	2	2	2	2	2	2	2	2

25	21	27	23	28	26	29	22	24
− 2	2	2	2	2	2	2	2	2

39. Repeat this exercise with 10 in place of 2, and again with 12 (by adding or taking out 10 and 2).

Threes

40. *Think rapidly the adding and subtracting of the following numbers:*

5	7	4	6	2	3	9	8	12	5
+ 3	3	3	3	3	3	3	3	3	3

7	5	6	14	9	18	11	16	8	10
− 3	3	3	3	3	3	3	3	3	3

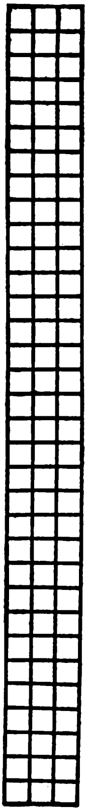
Proceed as on page 1.

41. 1 yd. + 2 ft. = x feet   1 yd. + 4 ft. = x feet

Think the yard as 3 feet in these exercises.

42. 1 yd. + 6 ft. = x feet   1 yd. + 3 ft. = x feet
43. 1 yd. + 5 ft. = x feet   1 yd. + 1 ft. = x feet
44. 1 yd. + 11 ft. = x feet   1 yd. + 7 ft. = x feet
45. 1 yd. + 9 ft. = x feet   1 yd. + 12 ft. = x feet
46. 9 ft. − 1 yd. = x feet   12 ft. − 1 yd. = x feet
47. 7 ft. − 1 yd. = x feet   5 ft. − 1 yd. = x feet
48. 8 ft. − 1 yd. = x feet   10 ft. − 1 yd. = x feet
49. 4 ft. − 1 yd. = x feet   11 ft. − 1 yd. = x feet
50. 14 ft. − 1 yd. = x feet   6 ft. − 1 yd. = x feet
51.* $2\frac{1}{2}$ yd. − 4 ft. = x feet $3\frac{1}{2}$ yd. + 6 ft. = x feet

52.* $1\frac{1}{2}$ yd. + 6 ft. = x feet $1\frac{1}{2}$ yd. = x inches
53.* $1\frac{1}{2}$ yd. ÷ 1 ft. = x $1\frac{1}{2}$ yd. + 6 in. = x in.
54. Count these squares by 3's.
55. Write the counts with figures.
56. Count them backward.
57.* 23 ft. + 13 ft. = x feet   23 ft. + 19 ft. = x
58.* 38 qt. − 23 qt. = x quarts   31¢ − 23¢ = x
59.* 5 yd. + 2 ft. = x feet   7 yd. − 5 ft. = x
60.* 4 yd. − 7 ft. = x feet   10 yd. − 5 ft. = x



61. *Think rapidly the addition and subtraction of the following numbers, just as on page* 1:

37	31	39	33	35	38	36	32	30
+ 3	3	3	3	3	3	3	3	3

35	37	38	39	31	34	36	32	33
− 3	3	3	3	3	3	3	3	3

62. Repeat this exercise with 20 in place of 3, and then with 23 (adding or taking out 20 and 3).

Fours

63. *During three minutes think rapidly the adding and subtracting of these numbers:*

2	6	3	7	4	13	5	9	8	12
+ 4	4	4	4	4	4	4	4	4	4

6	9	7	10	8	11	13	15	12	16
− 4	4	4	4	4	4	4	4	4	4

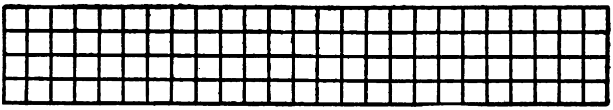
Liquid Measure

64. 1 gal. + 2 qt. = x quarts   1 gal. + 6 qt. = x quarts

1 gal. = x quarts. 4 qt. + 2 quarts = x quarts. Think 1 gal. as 4 qt.

65. 1 gal. + 3 qt. = x quarts   1 gal. + 5 qt. = x quarts

66. 1 gal. + 4 qt. = x quarts   1 gal. + 12 qt. = x quarts
67. 1 gal. + 11 qt. = x quarts   1 gal. + 7 qt. = x quarts
68. 1 gal. + 9 qt. = x quarts   1 gal. + 8 qt. = x quarts
69. 5 qt. − 1 gal. = x quarts   7 qt. − 1 gal. = x quarts
70. 9 qt. − 1 gal. = x quarts   6 qt. − 1 gal. = x quarts
71. 12 qt. − 1 gal. = x quarts   13 qt. − 1 gal. = x quarts
72. 10 qt. − 1 gal. = x quarts   11 qt. − 1 gal. = x quarts
73. 1 gal. = x pt.   1 gal. − 3 pt. = x pt.   1 gal. − 5 pt. = x pt.
74.* 1 gal. + 3 pt. = x pints   1 gal. + 2 qt. = x pints
75.* 2 gal. − 5 qt. = x quarts   3 gal. − 7 qt. = x quarts
76.* 2 gal. − 5 pt. = x pints   7 pt. + 1 gal. = x quarts



77. Count these squares by 4's.

78. Write the counts with figures.

79. Count them backward.

80.* How many quart jars will $5\frac{1}{2}$ gal. of milk fill?

81.* How many glasses (half pints) will 2 quart jars of milk fill?

82. *Think rapidly the adding and subtracting of these numbers, as on page* 1:

$$\begin{array}{rrrrrrrrrr} 37 & 31 & 39 & 32 & 36 & 35 & 38 & 33 & 34 & 30 \\ +\ 4 & 4 & 4 & 4 & 4 & 4 & 4 & 4 & 4 & 4 \\ \hline \end{array}$$

$$\begin{array}{rrrrrrrrrr} 35 & 34 & 39 & 33 & 38 & 32 & 37 & 30 & 31 & 36 \\ -\ 4 & 4 & 4 & 4 & 4 & 4 & 4 & 4 & 4 & 4 \\ \hline \end{array}$$

83. Repeat this exercise with 10 in place of 4, and then with 14 (10 and then 4).

Fives

84. *During 3 minutes think rapidly the adding and subtracting of these numbers:*

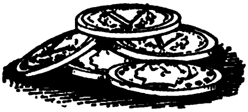
7	3	6	2	9	5	13	4	8	12
+ 5	5	5	5	5	5	5	5	5	5

7	10	8	11	13	16	14	12	17	9
+ 5	5	5	5	5	5	5	5	5	5

Proceed as on page 1.

Cents — Nickels

5 cents

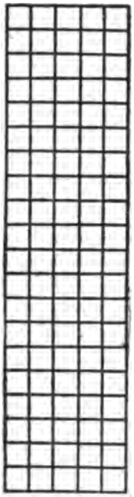


5 nickels

85. 1 nickel + 4¢ = x¢   1 nickel + 8¢ = x¢

Think the nickel as 5¢ in these exercises.

86. 1 nickel + 2¢ = x¢   1 nickel + 5¢ = x¢
87. 1 nickel + 3¢ = x¢   1 nickel + 9¢ = x¢
88. 1 nickel + 6¢ = x¢   1 nickel + 4¢ = x¢
89. 1 nickel + 7¢ = x¢   1 nickel + 11¢ = x¢
90. 7¢ − 1 nickel = x¢   12¢ − 1 nickel = x¢
91. 14¢ − 1 nickel = x¢   11¢ − 1 nickel = x¢
92. 9¢ − 1 nickel = x¢   8¢ − 1 nickel = x¢
93. 10¢ − 1 nickel = x¢   13¢ − 1 nickel = x¢
94.* 2 half dollars + 2 quarters = x¢
95.* 3 halves + 3 dimes = x¢
96.* 3 halves + 2 quarters = x dollars
97.* 1 half + 3 quarters − 18¢ = x¢



98. Count these squares by 5's.

99. Write the counts with figures.

100. Count them backward.

101.* A half dollar, 3 quarters, 2 dimes and 7 cents equals what?

102.* How much do 5 half dollars and 5 quarters equal?

103.* How much should be received for 2 qt. of milk sold at 5¢ a glass if the glass holds a half pint?

104.* A floor-plan was drawn to a scale of ½ in. to 1 ft. This means ½ in. of what? It means 1 ft. of what?

105. *Think rapidly the addition and subtraction of these numbers, as on page* 1:

60	68	64	66	69	63	67	65	61	62
+ 5	5	5	5	5	5	5	5	5	5

69	65	64	67	63	61	68	66	62	60
− 5	5	5	5	5	5	5	5	5	5

106. Repeat this exercise with 50 in place of 5, and then with 55 (50 and 5).

Sixes

107. *Think rapidly the adding and subtracting of these numbers, just as on page* 1:

7	3	6	2	9	5	13	4	8	12
+ 6	6	6	6	6	6	6	6	6	6

8	9	13	11	21	10	12	19	15	16
− 6	6	6	6	6	6	6	6	6	4

Half Dozen — Half Foot

108. $\frac{1}{2}$ ft. + 2 in. = x inches $\frac{1}{2}$ ft. +4 in. = x inches

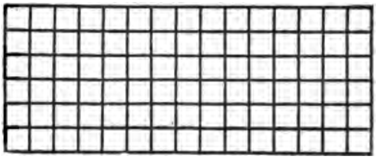
$\frac{1}{2}$ ft. = x inches   6 in. + 2 in. = x inches

109. $\frac{1}{2}$ ft. + 6 in. = x inches $\frac{1}{2}$ ft. +3 in. = x inches
110. $\frac{1}{2}$ ft. + 12 in. = x inches $\frac{1}{2}$ ft. +5 in. = x inches
111. 10 eggs $-\frac{1}{2}$ doz. = x eggs   8 eggs $-\frac{1}{2}$ doz. = x eggs
112. 12 eggs $-\frac{1}{2}$ doz. = x eggs   9 eggs $-\frac{1}{2}$ doz. = x eggs
113. 11 eggs $-\frac{1}{2}$ doz. = x eggs   15 eggs $-\frac{1}{2}$ doz. = x eggs

114. Count these squares by 6's.

115. Write the counts in figures.

116. Count them backward.



117. *Think rapidly the addition and subtraction of these numbers, just as on page* 1:

45	49	41	43	47	46	40	48	42	44
+ 6	6	6	6	6	6	6	6	6	6

46	40	48	42	44	49	45	41	45	43
− 6	6	6	6	6	6	6	6	6	6

118. Repeat this exercise with 30 in place of 6, and then with 36 (30 and 6).

Sevens

119. *Think rapidly the adding and subtracting of these numbers:*

2	6	3	7	4	13	5	9	12	8
+ 7	7	7	7	7	7	7	7	7	7

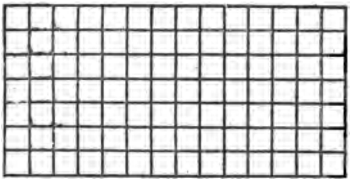
10	13	11	21	16	12	19	15	14	22
− 7	7	7	7	7	7	7	7	7	7

Weeks — Days

120. 1 wk. + 5 d. = x days   1 wk. + 3 d. = x days

1 wk. = x days   7 d. + 5 d. = x days

121. 1 wk. + 4 d. = x days   1 wk. + 6 d. = x days
122. 1 wk. + 2 d. = x days   1 wk. + 9 d. = x days
123. 1 wk. + 12 d. = x days   1 wk. + 7 d. = x days
124. 1 wk. + 8 d. = x days   1 wk. + 11 d. = x days
125. 9 d. − 1 wk. = x days   12 d. − 1 wk. = x days
126. 11 d. − 1 wk. = x days   14 d. − 1 wk. = x days
127. 16 d. − 1 wk. = x days   10 d. − 1 wk. = x days
128. 13 d. − 1 wk. = x days   18 d. − 1 wk. = x days
129. 25 d. − 2 wk. = x days   32 d. − 2 wk. = x days
130. 23 d. + 5 d. = x weeks   15 d. + 2 wk. = x days
131. 1 wk. + 11 d. = x days   26 d. + 9 d. = x weeks



132. Count these squares by 7's.

133. Write counts with figures.

134. Count them backward.

135.* Find the cost of $3\frac{1}{4}$ lb. of ham at 20¢ a pound. Of $4\frac{3}{4}$ lb.

136.* Of 9 grapefruit at the rate of 3 for 25¢.

137.* Of 15 grapefruit.

138.* Of $4\frac{3}{4}$ lb. of lobster @ 20¢.

139.* Of $1\frac{1}{4}$ lb. of steak @ 44¢.

140.* Of $2\frac{1}{2}$ lb. of steak @ 40¢.

141. *Think rapidly the addition and subtraction of these numbers, just as on page 1:*

89	85	81	83	87	88	80	84	86	82
+ 7	7	7	7	7	7	7	7	7	7

80	88	84	82	86	89	85	81	83	87
− 7	7	7	7	7	7	7	7	7	7

142. Repeat this exercise with 60 in place of 7, and then with 67 (60 and 7).

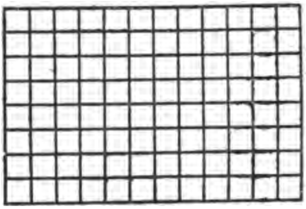
Eights

143. *Think rapidly the adding and subtracting of these numbers, just as on page 1:*

4	7	3	6	2	8	12	9	5	13
+ 8	8	8	8	8	8	8	8	8	8

16	11	21	10	13	17	12	15	22	14
− 8	8	8	8	8	8	8	8	8	8

Proceed as on page 1.



144. Count these squares by 8's.

145. Write the counts with figures.

146. Count them backward.

147.* 2 gal. − 5 qt. = x quarts.

148.* $3\frac{1}{2}$ gal. + 3 qt. = x gallons.

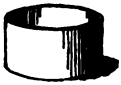
149.* 1 ft. + 18 in. = x inches. 30 in. = x feet.

150.* $1\frac{3}{4}$ ft. = x inches. 15 in. = x feet.

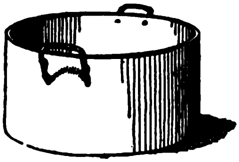
151.* 6 oranges = x dozen. 3 oranges = x dozen.

152.* 9 eggs = x dozen. 15 eggs = x dozen.

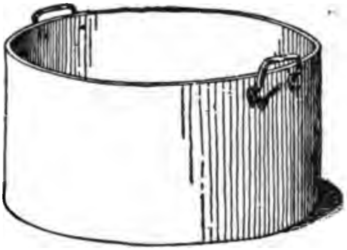
153.* 1 gal. = x pints. $\frac{1}{2}$ gal. = x pints.



Quart



Peck



Bushel

2 pints (pt.) = 1 quart (qt.)
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)

154. 1 pk. + 2 qt. = x quarts 1 pk. + 4 qt. = x quarts
155. 1 pk. + 6 qt. = x quarts 1 pk. + 3 qt. = x quarts
156. 1 pk. + 9 qt. = x quarts 1 pk. + 7 qt. = x quarts
157. 1 pk. + 5 qt. = x quarts 1 pk. + 8 qt. = x quarts
158. 15 qt. − 1 pk. = x quarts 20 qt. − 1 pk. = x quarts
159. 10 qt. − 1 pk. = x quarts 12 qt. − 1 pk. = x quarts
160. 14 qt. − 1 pk. = x quarts 11 qt. − 1 pk. = x quarts
161.* 27 qt. + 5 qt. = x quarts 13 qt. + 3 pk. = x quarts
162.* 15 qt. + $\frac{1}{2}$ bu. = x quarts 1 pk. + $\frac{1}{2}$ bu. = x quarts
163.* $2\frac{1}{2}$ pk. + 0 = x quarts 3 pk. − 20 qt. = x quarts

164. *Think rapidly the addition and subtraction of these numbers, as on page 1:*

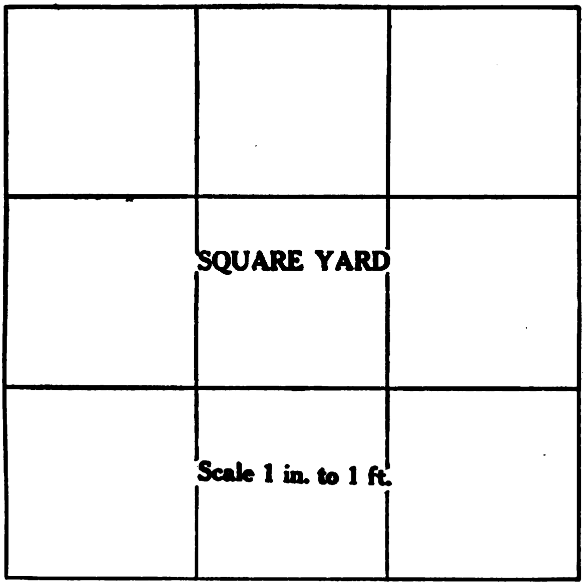
99	95	97	91	93	96	92	98	90	94
+ 8	8	8	8	8	8	8	8	8	8
92	98	94	96	90	95	99	93	97	91
− 8	8	8	8	8	8	8	8	8	8

165. Repeat this exercise with 80 in place of 8, and then with 88 (80 and 8).

Development Exercise

166. Let two pupils working together draw upon the blackboard a square whose sides are a yard long. Rule and measure the sides. This square is a **square yard.**

167. Another pupil divide the sides into feet. Two others mark off the square yard into square feet by ruled dotted lines.



168. An inch in the drawing in the book represents what length of the square yard?

See scale.

169. How many inches long is one side of the drawing?

170. The side of the square represented is how long?

171. How large are the small squares in the drawing?

172. How large squares do they represent?

173. How many square feet in a row across the square yard? How many rows in the square yard?

174. How many square feet in the square yard?

175. How long is 1 side of a square yard? 4 sides?

The distance round a surface is called its *perimeter*.

176. Find the perimeter of a rug 5 ft. by 3 ft.

Nines

177. *Think rapidly the adding and subtracting of these numbers, as on page* 1:

13	5	9	12	8	2	6	3	7	4
+ 9	9	9	9	9	9	9	9	9	9

16	11	17	25	13	24	12	15	18	14
− 9	9	9	9	9	9	9	9	9	9

Proceed as on page 1.

Square Feet — Square Yards

178. 1 sq. yd. + 2 sq. ft. = x square feet

In each of these exercises think the square yard as 9 square feet.

179. 1 sq. yd. + 6 sq. ft. = x square feet
180. 1 sq. yd. + 8 sq. ft. = x square feet
181. 1 sq. yd. + 12 sq. ft. = x square feet
182. 1 sq. yd. + 4 sq. ft. = x square feet
183. 1 sq. yd. + 7 sq. ft. = x square feet
184. 12 sq. ft. − 1 sq. yd. = x square feet
185. 10 sq. ft. − 1 sq. yd. = x square feet
186. 11 sq. ft. − 1 sq. yd. = x square feet
187. 15 sq. ft. − 1 sq. yd. = x square feet
188. 20 sq. ft. − 1 sq. yd. = x square feet

189.* Find the cost of 6 bananas at 20¢ a dozen. Of 3 bananas. Of 9.

190.* 2 pk. − 2 qt. = x quarts 1 pk. − 3 pt. = x pints.

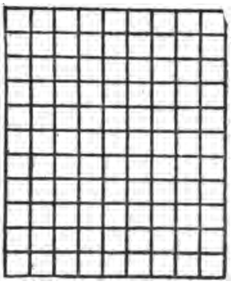
191. *Think rapidly the adding and subtracting of these numbers as on page* 1:

75	79	71	73	77	72	76	70	78	84
+ 9	9	9	9	9	9	9	9	9	9

73	75	71	77	79	70	78	74	76	74
− 9	9	9	9	9	9	9	9	9	9

192. Repeat this exercise with 40 in place of 9, and then with 49 (40 and 9).

Counting by Nines



193. Count these squares by 9's.

194. Write the counts with figures.

195. Count the squares backward.

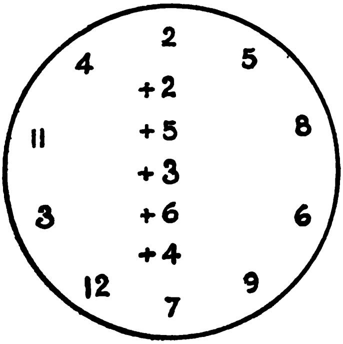
196.* $\frac{1}{3}$ sq. yd. $= x$ square feet

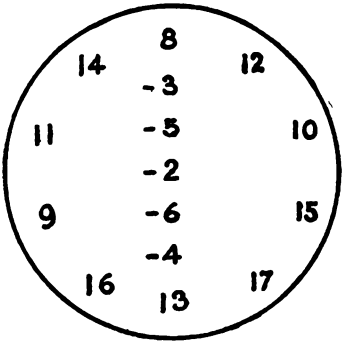
197.* $1\frac{1}{3}$ sq. yd. $= x$ square feet

198.* $2\frac{2}{3}$ sq. yd. $= x$ square feet

199.* Ned starts for school at 8.07 and is 17 minutes on the way. At what time does he arrive?

Review Drill





200. Add 2 quickly to each number on the circumference of the left circle. Then add 5 to each, then 3, 6, and 4 in order. Try it until you can do it without hesitating.

201. In the other circle, subtract in the same order.

How much money has a boy who had:

202. 12¢, and earned 7¢ more? 32¢, and spent 15¢?
203. 27¢, and spent 6¢? 32¢, and earned 25¢ more?
204. 37¢, and earned 5¢ more? 42¢, and earned 25¢ more?
205. 47¢, and earned 6¢ more? 42¢, and spent 7¢?
206. 25¢, and spent 7¢? 42¢, and spent 5¢?
207. 25¢, and spent 17¢? 42¢, and earned 9¢?

$25 - 10 - 7 = x$

208. 25¢, and earned 27¢ more? 42¢, and earned 16¢?

$25 + 20 + 7 = x$

209. 25¢, and earned 21¢ more? 42¢, and spent 3¢?
210. 25¢, and earned 13¢ more? 42¢, and spent 4¢?
211. 43¢, and spent 25¢? 43¢, and earned 24¢?

212	**213**	**214**	**215**	**216**
9	4	5	5	4
2	3	9	2	3
7	8	2	7	8
8	7	7	6	5
3	2	8	4	6
4	9	3	8	9
5	5	4	7	4
7	6	5	3	2
24	38	16	15	62

1. During 3 minutes think rapidly the adding of these columns:

2. At a signal from the teacher add each column, and write the sums in order in a line. Then stand quietly in the aisle at your left.

Teacher, note the number finishing within 3 minutes.

Proceed as on page 1.

Each practise until he can add the 5 columns in 2 minutes.

Proceed as above with the numbers given below:

217	**218**	**219**	**220**	**221**	**222**	**223**	**224**	**225**	**226**
4	6	8	3	5	7	9	2	3	6
8	5	7	9	2	4	6	8	3	5
7	9	2	4	6	8	3	5	7	9
2	4	6	8	3	5	7	9	2	4
6	8	3	5	7	9	2	4	6	8
5	7	9	2	4	6	8	9	3	5
27	19	32	4	6	8	3	5	7	9

Twos

1. Beginning with 2, write the counts by 2's to 30, and backward to 2.

2. In this counting we begin with 2, and add another 2 for each count, making the second count — 2's, the third count — 2's, the fourth count — 2's, etc.

3. *Learn this table:*

2 2's = 4   6 2's = 12   10 2's = 20
3 2's = 6   7 2's = 14   11 2's = 22
4 2's = 8   8 2's = 16   12 2's = 24
5 2's = 10   9 2's = 18   20 2's = 40

4. *Also practise giving tables in this way:*

2 2's = 4   2 3's = 6   2 4's = 8, etc.

5. *Learn:*

4 = 2 2's   12 = 6 2's   20 = 10 2's
6 = 3 2's   14 = 7 2's   22 = 11 2's
8 = 4 2's   16 = 8 2's   24 = 12 2's
10 = 5 2's   18 = 9 2's   40 = 20 2's

6. *Also repeat tables in this form:*

4 = 2 2's   6 = 2 3's, etc.

Halves

7. \$2 = x half dollars   5 in. = x half inches
8. \$7 = x half dollars   8 in. = x half inches
9. \$9 = x half dollars   12 in. = x half inches
10. \$3 = x half dollars   10 in. = x half inches
11. \$4 = x half dollars   20 in. = x half inches
12. 12 pt. = x quarts   10 half dollars = x dollars
13. 16 pt. = x quarts   14 half dollars = x dollars
14. 4 pt. = x quarts   24 half dollars = x dollars
15. \$2.50 = x half dollars   13 half dollars = x dollars
16. \$9.50 = x half dollars   21 half dollars = x dollars

Pints — Quarts

17. *During 2 minutes think rapidly how many pints each number of quarts in the line below equals and how many quarts each number of pints in the next line equals:*

Quarts 4, 2, 8, 12, 6, 3, 9, 7, 11, 10, 20, 5.
Pints 20, 4, 8, 16, 24, 14, 6, 10, 12, 18, 22, 40.

18. *During 4 minutes think rapidly twice each number in the first two lines below and half of each number in the following two lines:*

3, 30, 2, 20, 5, 50, 4, 40, 7, 70.
9, 90, 12, 120, 8, 80, 10, 100, 11, 110.
14, 140, 8, 80, 10, 100, 4, 40, 6, 60.
22, 220, 20, 200, 16, 160, 24, 240, 18, 180.

19. Proceed as on page 1, writing the answers in four lines.

20. If oak floor boards are 2 in. wide, how wide a space will 3 boards cover? 30 boards?

21. 2 boards? 20 boards? 5 boards? 50 boards?

22. How many boards will cover a space 1 ft. wide? $\frac{1}{2}$ ft. wide? $1\frac{1}{2}$ ft. wide?

Threes

23. Beginning with 3, write the counts by 3's to 36, and backward to 3.

24. In this counting we begin with —, and add another — for each count, making the second count — 3's, the third count — 3's, the fourth count — 3's, etc.

25. *Learn all tables to give in two ways, as with twos:*

2 3's = 6
3 3's = 9
4 3's = 12
5 3's = 15
6 3's = 18
7 3's = 21
8 3's = 24
9 3's = 27
10 3's = 30
11 3's = 33
12 3's = 36
20 3's = 60

26. 6 = 2 3's   18 = 6 3's   30 = 10 3's
9 = 3 3's   21 = 7 3's   33 = 11 3's
12 = 4 3's   24 = 8 3's   36 = 12 3's
15 = 5 3's   27 = 9 3's   60 = 20 3's

27. *During 2 minutes think rapidly how many feet each number of yards in the line below equals, and how many yards each number of feet in the next line equals:*

Yards 2, 6, 4, 7, 3, 9, 11, 12, 8, 5, 10.
Feet 33, 9, 6, 30, 15, 21, 27, 36, 18, 12, 24.

28. Write these answers in two lines.

29. *During 4 minutes think rapidly the product of each number in the first two lines below by* 3, *and the quotient of each number in the next* 2 *lines by* 3.

3, 30, 2, 20, 5, 50, 4, 40, 7, 70.
9, 90, 12, 120, 8, 80, 10, 100, 11, 110.
9, 90, 6, 60, 15, 150, 12, 120, 21, 210.
27, 270, 36, 360, 24, 240, 30, 300, 33, 330.

30. Proceed as on page 1, writing the answers in four lines.

31. If hard pine floor boards are 3 in. wide, how wide space will 3 boards lay? 5 boards? 8 boards?

32. How many will cover a space 1 ft. wide?

Fours

33. Beginning with 4, write the counts by 4's to 48, and backward to 4.

34. In this counting we begin with 4, and add another — for each count, making the second count — 4's, the third count — 4's, the fourth count — 4's, etc.

35. 2 4's = 8   6 4's = 24   10 4's = 40
3 4's = 12   7 4's = 28   11 4's = 44

4 4's = 16
5 4's = 20
8 4's = 32
9 4's = 36
12 4's = 48
20 4's = 80

8 = 2 4's
12 = 3 4's
16 = 4 4's
20 = 5 4's
24 = 6 4's
28 = 7 4's
32 = 8 4's
36 = 9 4's
40 = 10 4's
44 = 11 4's
48 = 12 4's
80 = 20 4's

Quarts — Gallons

36. *During 2 minutes think rapidly how many quarts each number of gallons in the line below equals, and how many gallons each number of quarts in the next line equals:*

Gallons 4, 7, 3, 5, 9, 2, 12, 10, 6, 11, 8.
Quarts 16, 24, 32, 8, 20, 40, 12, 36, 48, 28, 44.
Proceed as on page 1.

37. How many quart jars will 6 gallons fill? 4 gallons? 9 gallons? 7 gallons? 5 gallons?

38. *During 4 minutes think rapidly the product of each number in the first 2 lines below by 4, and the quotient of each number in the next 2 lines by 4:*

3, 30, 2, 20, 5, 50, 4, 40, 7, 70.
9, 90, 12, 120, 8, 80, 10, 100, 11, 110.
8, 80, 12, 120, 16, 120, 20, 200, 28, 280.
40, 400, 32, 320, 48, 480, 36, 360, 44, 440.

39. Proceed as on page 1, writing answers in four lines.

Fives

40. Beginning with 5, write the counts by 5's to 60, and backward to 5.

41. In this counting we begin with —, and add another — for each count, making the second count — 5's, the third count — 5's, the fourth count — 5's, etc.

42. 2 5’s = 10
3 5’s = 15
4 5’s = 20
5 5’s = 25
6 5’s = 30
7 5’s = 35
8 5’s = 40
9 5’s = 45
10 5’s = 50
11 5’s = 55
12 5’s = 60
20 5’s = 100

43. 10 = 2 5’s
15 = 3 5’s
20 = 4 5’s
25 = 5 5’s
30 = 6 5’s
35 = 7 5’s
40 = 8 5’s
45 = 9 5’s
50 = 10 5’s
55 = 11 5’s
60 = 12 5’s
100 = 20 5’s

Cents — Nickels

44. *During 2 minutes think rapidly how many cents each number of nickels in the first line below equals in value, and how many nickels each number of cents in the next line equals:*

Nickels 6, 8, 10, 7, 4, 2, 9, 3, 5, 11, 12, 20.
Cents 20, 40, 15, 30, 45, 60, 50, 10, 25, 35, 55, 100.

45. Proceed as on page 1.

46. *During 4 minutes think rapidly the product of each number in the first 2 lines below by 5, and the quotient of each number in the next 2 lines by 5:*

5, 50, 3, 30, 7, 70, 9, 90, 6, 60.
4, 40, 11, 110, 2, 20, 8, 80, 12, 120.
15, 150, 10, 100, 25, 250, 20, 200, 35, 350.
45, 450, 60, 600, 40, 400, 50, 500, 55, 550.

47. Proceed as on page 1, writing answers in 4 lines.

Sixes

48. Beginning with 6, write the counts by 6’s to 72, and backward to 6.

49. In this counting we begin with —, and add another — for each count, making the second count — 6’s, the third count — 6’s, etc.

50. 2 6's = 12
3 6's = 18
4 6's = 24
5 6's = 30
6 6's = 36
7 6's = 42
8 6's = 48
9 6's = 54
10 6's = 60
11 6's = 66
12 6's = 72
20 6's = 120

51. 12 = 2 6's
18 = 3 6's
24 = 4 6's
30 = 5 6's
36 = 6 6's
42 = 7 6's
48 = 8 6's
54 = 9 6's
60 = 10 6's
66 = 11 6's
72 = 12 6's
120 = 20 6's

Half Feet — Yards

52. 1 yard = x half feet.

53. *During 3 minutes think rapidly how many half feet each number of yards in the first line below equals, and how many yards each number of half feet in the next line equals:*

Yards 2, 5, 7, 3, 9, 4, 11, 6, 12, 10.
Half feet 24, 42, 48, 72, 18, 12, 36, 54, 60, 66.

54. Proceed as on page 1.

55. Round steak was sold at 25¢ a pound, and beef roast at 18¢ a pound. How much less did a pound of roast cost than a pound of steak? How much less would 6 lb. of roast cost than 6 lb. of steak?

56. Oranges are bought at the rate of 6 for 12¢. How much is that apiece?

57. They are sold at the rate of 6 for 18¢. How much is that apiece? How much is the gain on an orange?

58. The gain on the orange equals what part of the cost?

59. How many 6-inch boards will cover a space 54 in. wide?

60. If 2 grapefruit can be bought for 25¢, how much will 6 cost?

61. In a restaurant the pies were cut into sixths.

4 pies = x sixths 6 pies = x sixths 8 pies = x sixths

62. *During* 4 *minutes think rapidly the product of each number in the first* 2 *lines below by* 6 *and the quotient of each number in the next* 2 *lines by* 6.

3, 30, 2, 20, 5, 50, 4, 40, 7, 70.
9, 90, 12, 120, 8, 80, 10, 100, 11, 110.
48, 480, 18, 180, 12, 120, 30, 300, 24, 240.
60, 600, 54, 540, 72, 720, 48, 480, 60, 600.

63. Proceed as on page 1, writing answers in four lines.

Sevens

64. Beginning with 7, write the counts by 7's to 84, and backward to 7.

65. In this counting we begin with —, and add another — for each count, making the second count — 7's, the third count — 7's, the fourth count — 7's, etc.

66. 2 7's = 14 6 7's = 42 10 7's = 70
3 7's = 21 7 7's = 49 11 7's = 77
4 7's = 28 8 7's = 56 12 7's = 84
5 7's = 35 9 7's = 63 20 7's = 140

67. 14 = 2 7's 42 = 6 7's 70 = 10 7's
21 = 3 7's 49 = 7 7's 77 = 11 7's
28 = 4 7's 56 = 8 7's 84 = 12 7's
35 = 5 7's 63 = 9 7's 140 = 20 7's

Weeks — Days

68. *During* 3 *minutes think rapidly how many days each number of weeks in the line below equals, and how many weeks each number of days in the next line equals:*

Weeks 7, 4, 6, 3, 2, 9, 5, 8, 11, 12, 20.
Days 28, 42, 21, 49, 63, 14, 84, 35, 56, 77, 140.

69. Proceed as on page 1.

70.* 6 wk. = x days 60 wk. = x days
71.* 5 wk. + 6 d. = x days 50 wk. + 2 d. = x days
72.* 4 wk. + 3 d. = x days 50 d. = x weeks

73. *During 4 minutes think rapidly the product of each number in the first 2 lines below by 7, and the quotient of each number in the next 2 lines by 7.*

3, 30, 2, 20, 5, 50, 4, 40, 7, 70.
9, 90, 12, 120, 8, 80, 10, 100, 11, 110.
28, 280, 14, 140, 21, 210, 35, 350, 49, 490.
63, 630, 56, 560, 70, 700, 84, 840, 77, 770.

74. Proceed as on page 1, writing answers in four lines.

Eights

75. Beginning with eight, write the counts by 8's to 96, and backward to 8.

76. 2 8's = 16
3 8's = 24
4 8's = 32
5 8's = 40
6 8's = 48
7 8's = 56
8 8's = 64
9 8's = 72
10 8's = 80
11 8's = 88
12 8's = 96
20 8's = 160

77. 16 = 2 8's
24 = 3 8's
32 = 4 8's
40 = 5 8's
48 = 6 8's
56 = 7 8's
64 = 8 8's
72 = 9 8's
80 = 10 8's
88 = 11 8's
96 = 12 8's
160 = 20 8's

Pecks — Quarts

78. *During 3 minutes think rapidly how many quarts each number of pecks in the line below equals, and how many pecks each number of quarts in the next line equals:*

Pecks 8, 5, 7, 9, 4, 2, 6, 12, 3, 11, 10, 20.
Quarts 16, 32, 72, 56, 40, 64, 88, 24, 96, 48, 80, 160.
Proceed as on page 1.

79.* How many quarts in 3 pk.? In 30 pk.?
80.* How many pecks in 75 qt.? In 720 qt.?
81.* How many weeks in 350 d.? In 365 d.?

82. *During 4 minutes think rapidly the product of each number in the first 2 lines below by 8, and the quotient of each number in the next 2 lines by 8:*

3, 30, 2, 20, 5, 50, 4, 40, 7, 70.
9, 90, 12, 120, 8, 80, 10, 100, 11, 110.
56, 560, 24, 240, 16, 160, 40, 400, 32, 320.
96, 960, 64, 640, 80, 800, 88, 880, 72, 720.

83. Proceed as on page 1, writing answers in four lines.

Nines

84. Beginning with 9, write the counts by 9's to 108, and backward to 9.

85. In this counting we begin with —, and add another — for each count, making the second count — 9's, etc.

86. 2 9's = 18
3 9's = 27
4 9's = 36
5 9's = 45
6 9's = 54
7 9's = 63
8 9's = 72
9 9's = 81
10 9's = 90
11 9's = 99
12 9's = 108
20 9's = 180

87. 18 = 2 9's
27 = 3 9's
36 = 4 9's
45 = 5 9's
54 = 6 9's
63 = 7 9's
72 = 8 9's
81 = 9 9's
90 = 10 9's
99 = 11 9's
108 = 12 9's
180 = 20 9's

Square Yards — Square Feet

88. *During 3 minutes think rapidly how many square feet each number of square yards in the line below equals, and how many square yards each number of square feet in the next line equals:*

Square yards 2, 11, 3, 12, 6, 4, 9, 7, 5, 8, 10, 20.
Square feet 72, 45, 63, 81, 36, 18, 54, 108, 27, 99.
Proceed as on page 1.

89. Beginning with 10, count by 10's to 250, and backward to 10.

90. In this counting we begin with —, and add another — for each count, making the second count — 10's, the third count — 10's, etc.

91. Beginning with 2 10's, write the multiplication table of 10's to 25 10's.

92. Write this table in the form, beginning with 10 2's.

93. Write the division table of tens, beginning with 20 = 2 10's, and going to 250 = 25 10's.

94. Write this table in the other form, beginning with 20 = 10 2's.

Tens — Cents — Dimes — Dollars

5 cents

5 dimes

1 dollar

95. How many dimes in a dollar?

96. A dime is what part of a dollar?

97. How many tenths in a dollar?

98. We may write 2 and 5-tenths dollars with figures in this way. $2.5. Write it in words.

99. The dot between the 2 and the 5 is called a **decimal point**; and **the figure next at the right of it expresses tenths.** Write 7-tenths dollars with figures, dollar sign, and decimal point.

100. Seven-tenths of a dollar equals how many dimes?

101. Write in words $7.3, $4.9, and $8.5.

102. Write with dollar sign, figures and decimal point five dollars, two dimes, and four cents.

Review 95-102 rapidly.

103. How many cents equal a dollar?

104. One cent is what part of a dollar? Two cents are what part of a dollar? Seven cents?

The old meaning of cent is hundredth.

105. We write 7 cents with the dollar sign and figures in this way: $.07. The second figure at the right of the decimal point expresses hundredths. What is 1-hundredth of a dollar? What is 8-hundredths of a dollar?

106. Write with the dollar sign, decimal point, and figures 5 cents, 19 cents, 23 cents.

107. Write with the sign, decimal point, and figures the amount of two dimes and four cents.

108. Two dimes equal how many cents? Would you say that the price of a notebook was 2 dimes, or 20 cents?

109. Write the words which you would speak in reading the amount of money written in 107.

110. What do we commonly say instead of 4 dimes? Instead of three dimes and 7 cents? Instead of 7 dimes and 9 cents?

111. 245 cents $= x$ dollars and x cents.

112. Write with dollar sign, decimal point, and figures 679 cents.

113. Write in words $1.67 and $325.09.

114.* Write with dollar sign, decimal point, and figures 1673 cents, 23273 cents, 93 cents, 29195 cents, and 967838 cents.

Elevens

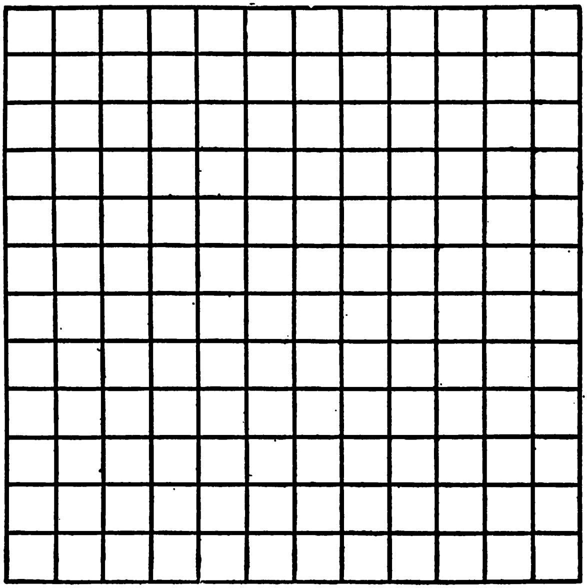
115. Beginning with 11, write the counts by 11's to 132, and backward to 11.

116. In this counting we begin with —, and add another — for each count, making the second count — 11's, the third count — 11's, etc.

117. 2 11's = 22
3 11's = 33
4 11's = 44
5 11's = 55
6 11's = 66
7 11's = 77
8 11's = 88
9 11's = 99
10 11's = 110
11 11's = 121
12 11's = 132
20 11's = 220

118. 22 = 2 11's
33 = 3 11's
44 = 4 11's
55 = 5 11's
66 = 6 11's
77 = 7 11's
88 = 8 11's
99 = 9 11's
110 = 10 11's
121 = 11 11's
132 = 12 11's
220 = 20 11's

Twelves



These lines represent lines four times as long.

119. How large a square is represented by this diagram?

Measure

120. The small squares represent how large squares?

121. How many inch squares in 1 row? In 2 rows? 3 rows? 4 rows?

122. In 5 rows? 6 rows? 7 rows? 8 rows? 9 rows?

123. 10 rows? 11 rows? In the square foot? $\frac{1}{2}$ sq. ft.?

124.* In $2\frac{1}{2}$ rows? $3\frac{1}{4}$ rows? $7\frac{3}{4}$ rows? $9\frac{1}{2}$ rows?

125. Beginning with 12, write the counts by 12's to 144, and backward to 12.

126. In the counting we begin with —, and add another — for each count, making the second count — 12's, the third count — 12's, etc.

127. 2 12's = 24
3 12's = 36
4 12's = 48
5 12's = 60
6 12's = 72
7 12's = 84
8 12's = 96
9 12's = 108
10 12's = 120
11 12's = 132
12 12's = 144
20 12's = 240

128. 24 = 2 12's
36 = 3 12's
48 = 4 12's
60 = 5 12's
72 = 6 12's
84 = 7 12's
96 = 8 12's
108 = 9 12's
120 = 10 12's
132 = 11 12's
144 = 12 12's
240 = 20 12's

Feet—Inches.

129. *Think these feet rapidly as inches, and the inches as feet for* 3 *minutes:*

Feet 3, 5, 7, 2, 9, 6, 11, 4, 8, 12, 10, 20.
Inches 60, 36, 84 108, 24, 72, 48, 96, 144, 132, 120.

130. Proceed as on page 1.

131. *During* 4 *minutes think rapidly the products of the numbers in the first* 2 *lines below by* 12 *and the quotients of the numbers in the next* 2 *lines by* 12:

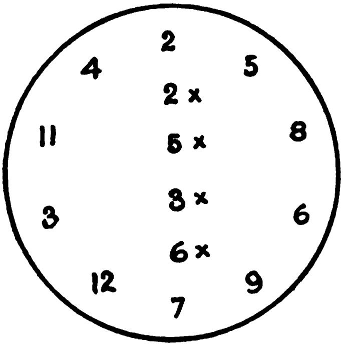
3, 30, 2, 20, 5, 50, 4, 40, 7, 70.
9, 90, 12, 120, 8, 80, 10, 100, 11, 110.
84, 840, 36, 360, 24, 240, 60, 600, 48, 480.
132, 1320, 108, 1080, 144, 1440, 96, 960, 120, 1200.

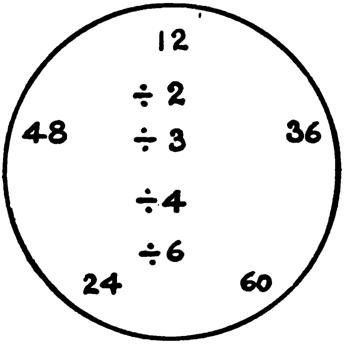
132. Proceed as on page 1, writing answers in four lines.

133.* $12\times4=x$ $12\times40=x$ $12\times44=x$ $12\times42=x$

134.* $12\times7=x$ $12\times70=x$ $12\times77=x$ $12\times73=x$

Review Drill





135. Multiply quickly each number in the circle at the left by 2. Then multiply each by 5. Then by 3 and 6, in order. Practise this until you can go through it without hesitating.

136. In the circle at the right, divide each number first by 2, then by 3, 4, and 6.

137.* Find the cost of 6 qt. 1 pt. of milk at 8¢.

138.* Of $3\frac{1}{2}$ lb. of halibut at 20¢.

139.* Of $1\frac{3}{4}$ lb. of steak at 40¢.

Thirteens

140. Beginning with thirteen, count by 13's to 78, and backward to 13.

141. Beginning with 2 13's, write the multiplication of 13's to 6 13's.

142. Write the division table of 13's from 26 = 2 13's to 78 = 6 13's.

143. There are 52 full weeks in a year. How many in $\frac{1}{4}$ of a year? In $\frac{1}{2}$ year? In $\frac{3}{4}$ year?

Fourteens

144. Beginning with 14, count by 14's to 98, and backward to 14.

145. Beginning with 2 14's, write the multiplication table of 14's to 7 14's.

146. Write the division table of 14's from 28 = 2 14's to 98 = 7 14's.

147. How many days in 2 fortnights? In 5 fortnights? In 7 fortnights?

Fifteens

148. Beginning with 15, count by 15's to 150, and backward to 15.

149. Write the multiplication table of 15's from 2 15's to 10 15's.

150. Write the division table of 15's from 30 = 2 15's to 150 = 10 15's.

151. Find the cost 5 collars @ 15¢ each. Of 9 collars. Of 6 collars. Of 8 collars.

Sixteens

152. Beginning with 16, count by 16's to 144, and backward to 16.

153. Write the multiplication table of 16's from 2 16's to 9 16's.

154. Write the division table of 16's from 32 = 2 16's to 144 = 9 16's.

155. A cord foot of wood equals 16 cubic feet. How many cubic feet in 3 cord feet? In 4 cord feet? In 6 cord feet? How many cord feet in 144 cu. ft.?

156. How many ounces in 3 lb.? In 5 lb?. In 8 lb.? In 4 lb.? In 6 lb.? In 9 lb.? In 2 lb.?

157. Find the cost of 5 boxes of strawberries @ 16¢. Of 7 boxes. Of 4 boxes. Of 8 boxes. Of 3 boxes.

Seventeens

158. Beginning with 17, count by 17's to 102, and backward to 17.

159. Write the multiplication table of 17's from 2 17's to 6 17's.

160. Write the division table from 34 = 2 17's to 102 = 6 17's.

161. Find the cost of 3 yd. of drilling @ 17¢. Of 6 yd. Of 4 yd. Of 5 yd. Of 2 yd.

Eighteens

162. Beginning with 18, count by 18's to 144, and backward to 18.

163. Write the multiplication table of 18's from 2 18's to 8 18's.

164. Write the division table of 18's from 36 = 2 18's to 144 = 8 18's.

165. Find the cost of 8 boxes of raspberries @ 18¢. Of 3 boxes. Of 5 boxes. Of 6 boxes. Of 4 boxes.

Nineteens

166. Beginning with 19 count by 19's to 95, and backward to 19.

167. Write the multiplication table of 19's from 2 19's to 5 19's.

168. Write the division table of 19's from 38 = 2 19's to 95 = 5 19's.

169. Find the cost of 2 yards of ribbon @ 19¢. Of 3 yd. Of 2 yd. Of 5 yd.

170. Of 3 lb. of lobster @ 19¢. Of 6 lb. Of 7 lb. Of 4 lb. Of 2 lb.

171. Of 2 pocket knives @ 19¢. Of 4 knives. Of 3 knives. Of 6 knives.

Twenty-ones — Twenty-twos

172. Beginning with 21, count by 21's to 105, and backward to 21.

173. Write the multiplication table of 21's from 2 21's to 5 21's.

174. Write the division table of 21's from 42 = 2 21's to 105 = 5 21's.

175. Find the cost of 3 handkerchiefs @ 21¢. Of 2. Of 5.

176. Beginning with 22, count by 22's to 110, and backward to 22.

177. Write the multiplication table of 22's from 2 22's to 5 22's.

178. Write the division table of 22's from 44 = 2 22's to 110 = 5 22's.

179. How many suits of clothes @ $22 each could be bought for $88? For $66? For $110?

Twenty-fours — Twenty-fives

180. Beginning with 24, count by 24's to 144, and backward to 24.

181. Write the multiplication table of 24's from 2 24's to 6 24's.

182. Write the division table from 48 = 2 24's to 144 = 6 24's.

183. How many inch cubes will make 3 rows each 24 in. long? How many will make 5 rows? 2 rows? 6 rows?

184. Beginning with 25, count by 25's to 625, and backward to 25.

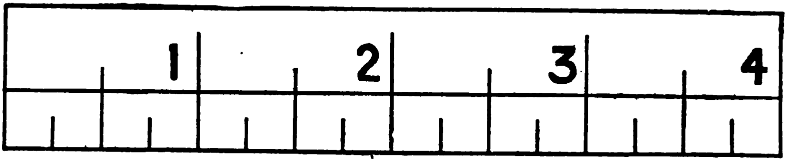
185. How many 25's in 100? In 200? In 500? In 700? In 1000?

186. 10 25's $= x$ 7 25's $= x$ 13 25's $= x$

187. 15 25's $= x$ 32 25's $= x$ 37 25's $= x$

188. Find the cost of 5 bunches of asparagus @ 24¢.

Halves — Fourths



Think these exercises upon the rule as suggested below. The children must know $\frac{1}{2}$ in., and that $\frac{2}{4}$ equal $\frac{1}{2}$.

1. $1\frac{1}{2}$ in. + $\frac{1}{2}$ in. = x inches

See how much $1\frac{1}{2}$ in. on the rule is, and how much $\frac{1}{2}$ in. more makes.

2. $1\frac{1}{2}$ in. + $\frac{1}{4}$ in. = x inches $1\frac{1}{4}$ in. + $\frac{1}{2}$ in. = x inches
3. $2\frac{1}{2}$ in. + $\frac{1}{4}$ in. = x inches $3\frac{1}{4}$ in. + $\frac{1}{4}$ in. = x inches
4. $2\frac{1}{2}$ in. + $1\frac{1}{4}$ in. = x inches $2\frac{1}{4}$ in. + $1\frac{1}{4}$ in. = x inches
5. 2 in. − $\frac{1}{2}$ in. = x inches $1\frac{3}{4}$ in. + $\frac{1}{2}$ in. = x inches

See how much 2 in. on the rule is, take $\frac{1}{2}$ in. out of this, and see how much is left.

6. $2\frac{1}{4}$ in. − $\frac{1}{2}$ in. = x inches   2 in. − $\frac{1}{4}$ in. = x inches
7. 2 in. − $\frac{3}{4}$ in. = x inches   2 in. − $1\frac{1}{2}$ in. = x inches
8. 2 in. − $1\frac{1}{4}$ in. = x inches $2\frac{1}{2}$ in. − $\frac{1}{4}$ in. = x inches

Think these exercises upon the rule.

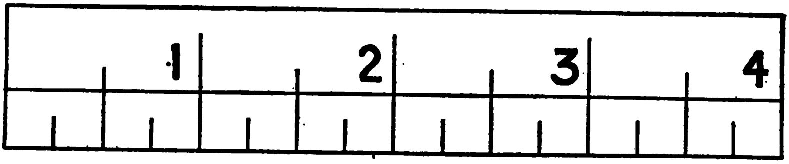
9. $1\frac{3}{4}$ in. + $1\frac{1}{4}$ in. = x inches $1\frac{3}{4}$ in. − $1\frac{1}{2}$ in. = x inches
10. $1\frac{1}{4}$ in. − $\frac{3}{4}$ in. = x inches $1\frac{1}{2}$ in. + $1\frac{3}{4}$ in. = x inches
11. $2\frac{1}{2}$ in. ÷ $\frac{1}{2}$ in. = x

See how many half inches in $2\frac{1}{2}$ inches.

12. $1\frac{1}{2}$ in. ÷ $\frac{1}{2}$ in. = x $3\frac{1}{2}$ in. ÷ $\frac{1}{2}$ in. = x
13. $1\frac{1}{2}$ in. ÷ $\frac{1}{4}$ in. = x $1\frac{1}{2}$ in. ÷ $\frac{3}{4}$ in. = x
14. $1\frac{1}{4}$ in. ÷ $\frac{1}{2}$ in. = x

See how many half inches and what part of another half inch in $1\frac{1}{4}$ in.

15.* $2\frac{1}{4}$ in. ÷ $\frac{1}{2}$ in. = x $3\frac{1}{4}$ in. ÷ $\frac{3}{4}$ in. = x
16.* $3\frac{1}{2}$ in. ÷ $\frac{3}{4}$ in. = x $2\frac{1}{2}$ in. ÷ $\frac{3}{4}$ in. = x



Think these exercises upon the rule. Count the parts if necessary.

17. Half of $\frac{1}{2}$ in. $= x$

18. $2\frac{1}{2}$ in. $= x$ fourth inches

19. $3\frac{1}{2}$ in. $= x$ fourth inches

20. $1\frac{1}{2}$ in. $+ \frac{1}{4}$ in. $= x$ inches

21. $1\frac{1}{2}$ in. $+ \frac{3}{4}$ in. $= x$ inches

22. $1\frac{1}{2}$ in. $- \frac{3}{4}$ in. $= x$ inches

23. Half of $1\frac{1}{2}$ in. $= x$ inches

24. $3\frac{1}{4}$ in. $\div \frac{1}{2}$ in. $= x$

How many half inches in $3\frac{1}{4}$ inches?

25. $3\frac{3}{4}$ in. $-2\frac{1}{2}$ in. $= x$ inches

Find $3\frac{3}{4}$ in. Take out $\frac{1}{2}$ in. and 2 in. and see what is left.

26. Half of $2\frac{1}{2}$ in. $= x$ inches

27. $2\frac{1}{4}$ in. $+ \frac{1}{2}$ in. $= x$ inches $2\frac{1}{4}$ in. $- \frac{1}{2}$ in. $= x$ inches

28. $2\frac{1}{2}$ in. $+ \frac{1}{4}$ in. $= x$ inches $2\frac{1}{2}$ in. $- \frac{1}{4}$ in. $= x$ inches

29. $2\frac{1}{2}$ in. $+ \frac{3}{4}$ in. $= x$ inches $2\frac{1}{2}$ in. $- \frac{3}{4}$ in. $= x$ inches

Work all that you can of these exercises without looking at the rule. Work the others upon the rule.

30. 1 in. $= x$ half inches 1 in. $= x$ quarter inches

31. $\frac{1}{2}$ in. $- \frac{1}{4}$ in. $= x$ inches $\frac{3}{4}$ in. $- \frac{1}{4}$ in. $= x$ inches

32. $\frac{1}{2}$ in. $+ \frac{1}{4}$ in. $= x$ inches $\frac{3}{4}$ in. $+ \frac{1}{4}$ in. $= x$ inches

33. $\frac{3}{4}$ in. $- \frac{1}{2}$ in. $= x$ inches $\frac{3}{4}$ in. $+ \frac{1}{2}$ in. $= x$ inches

34. $1\frac{1}{2}$ in. $\div \frac{1}{4}$ in. $= x$ $1\frac{1}{2}$ in. $\div \frac{3}{4}$ in. $= x$

35. $1\frac{1}{4}$ in. $\div \frac{1}{2}$ in. $= x$

See how many half inches and what part of another half inch in $1\frac{1}{4}$ in.

36. $1\frac{1}{4}$ in. − $\frac{1}{2}$ in. = x inches $1\frac{1}{4}$ in. − $\frac{3}{4}$ in. = x inches

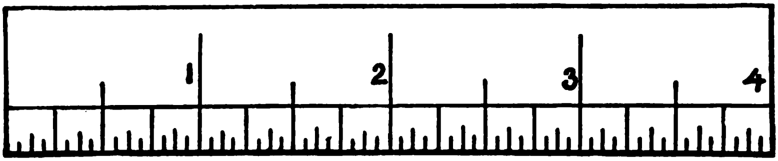
37. $1\frac{3}{4}$ in. + $\frac{1}{2}$ in. = x inches $2\frac{1}{4}$ in. − $\frac{1}{2}$ in. = x inches

38. $2\frac{1}{4}$ in. − $1\frac{1}{2}$ in. = x inches $2\frac{1}{4}$ in. − $\frac{3}{4}$ in. = x inches

39.* How much is gained by buying a pie for 10¢ and selling it @ 5¢ a quarter?

40.* Buying one for 12¢ and selling @ 5¢ a sixth?

41.* By buying milk @ 8¢ a quart and selling it at 5¢ a glass ($\frac{1}{2}$ pint)?



42. $1\frac{1}{2}$ in. + $\frac{3}{16}$ in. = x

See how much $1\frac{1}{2}$ in. is on the rule, and how much $\frac{3}{16}$ in. more makes.

43. $\frac{3}{4}$ in. − $\frac{5}{16}$ in. = x

Take $\frac{5}{16}$ in. out of $\frac{3}{4}$ in. upon the rule to find how much is left.

44. $2\frac{1}{4}$ in. ÷ $\frac{3}{4}$ in. = x

Find upon the rule how many $\frac{3}{4}$ in. in $2\frac{1}{4}$ in.

45. $\frac{2}{3}$ of $3\frac{3}{8}$ in. = x

Think $\frac{2}{3}$ of 3 in. and $\frac{2}{3}$ of 3 eighths inches.

46. $3\frac{5}{8}$ in. − $1\frac{3}{16}$ in. = x $1\frac{7}{8}$ in. + $2\frac{1}{16}$ in. = x

47. $3\frac{3}{4}$ in. ÷ $\frac{3}{4}$ in. = x $2\frac{1}{2}$ in. − $1\frac{3}{16}$ in. = x

48.* $2\frac{1}{4}$ in. + $\frac{5}{16}$ in. = x $2\frac{1}{4}$ in. − $1\frac{11}{16}$ in. = x

49.* A man had $6\frac{3}{4}$ acres of land, and sold $\frac{1}{2}$ of it. How much had he left?

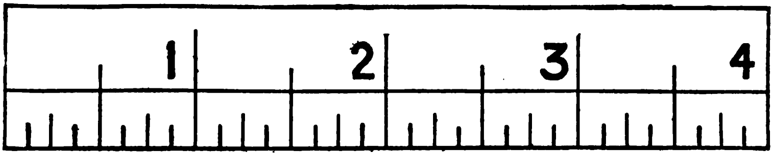
50.* $2\frac{11}{16}$ in. − $1\frac{1}{2}$ in. = x $2\frac{3}{4}$ in. − $1\frac{3}{16}$ in. = x

51.* $3\frac{5}{8}$ in. + $1\frac{1}{4}$ in. = x $1\frac{3}{8}$ in. − $1\frac{1}{16}$ in. = x

52.* $3\frac{1}{2}$ in. − $3\frac{8}{16}$ in. = x $2\frac{3}{4}$ in. + $1\frac{8}{16}$ in. = x

53.* $1\frac{1}{2}$ in. ÷ $\frac{3}{8}$ in. = x $2\frac{1}{2}$ in. ÷ $\frac{5}{16}$ in. = x

Changing Inches to Halves, Fourths, Eighths, etc.



Think these parts on the rule.

54. 3 in. $= x$ fourths $\qquad \frac{1}{2}$ in. $= x$ fourths
55. $2\frac{1}{2}$ in. $= x$ fourths $\qquad 2$ in. $= x$ eighths
56. $\frac{3}{4}$ in. $= x$ eighths $\qquad 1\frac{3}{4}$ in. $= x$ eighths
57. $2\frac{1}{2}$ in. $= x$ eighths $\qquad 2\frac{1}{4}$ in. $= x$ eighths
58. $\frac{12}{8}$ in. $= x$ halves $\qquad \frac{12}{8}$ in. $= x$ fourths
59. $\frac{12}{8}$ in. $\div \frac{1}{2}$ in. $= x$ $\qquad \frac{10}{8}$ in. $\div \frac{1}{4}$ in. $= x$
60. $1\frac{3}{4}$ in. $\div \frac{1}{4} = x$
61. $\frac{1}{2} = x$ sixteenths $\qquad \frac{3}{4} = \frac{x}{16} \qquad \frac{5}{8} = \frac{x}{16}$

How many fourths in $1\frac{3}{4}$?

Numerator — Denominator

62. Draw an inch, divide it into fourths, and draw a curve from the beginning to the end of $\frac{3}{4}$ of the inch.

A part of anything consisting of one or more equal parts of the whole is a fraction.

63. How many equal parts in the inch which you drew?

The number of equal parts in the whole is the *denominator* of the fraction.

The figure or word which expresses this number is also called the denominator.

64. The old meaning of denominator is *namer*.

Of what does the denominator tell the name?

65. How many equal parts in the *fraction* which you drew?

The number of equal parts in the fraction is its ***numerator.***

The old meaning of numerator is *numberer*. What does it number? The figure or word which expresses this number is also called the numerator.

The numerator and denominator are called the ***terms*** **of the fraction.**

66. What is the numerator of three-eighths? What is its denominator?

67. Write the fraction three-eighths with a figure and a word. Write it with two figures.

68. What does the 3 show? The 8?

69. When expressed by figures where is the numerator written? Where is the denominator written?

Changing Whole or Mixed Numbers to Fractional Numbers

70. 1 dollar = x quarters 2 dollars = x quarters
71. \$$2\frac{1}{2}$ = x halves \$$2\frac{1}{2}$ = x quarters

A number made of both wholes and parts, like \$$2\frac{1}{2}$, is called **a mixed number.**

Notice which of the following numbers are mixed.

72. \$$4\frac{1}{2}$ = x halves $1\frac{1}{8}$ in. = x eighths
73. \$$4\frac{1}{2}$ = x quarters $2\frac{7}{8}$ in. = x eighths
74. $2\frac{3}{4}$ in. = x fourths $1\frac{7}{16}$ in. = x sixteenths
75. $3\frac{1}{2}$ yd. = x quarters $5\frac{3}{4}$ yd. = x quarters
76. \$$9\frac{1}{2}$ = x halves \$$6\frac{3}{4}$ = x quarters

77. What is the numerator of a fraction? What is the denominator? What is the numerator of $\frac{9}{16}$? The denominator?

78. $6\frac{1}{2}$ in. = $\frac{x}{4}$ in. $6\frac{1}{2}$ in. = $\frac{x}{8}$ in. $6\frac{1}{2}$ in. = $\frac{x}{16}$ in.
79. $3\frac{1}{4}$ yd. = $\frac{x}{4}$ yd. $3\frac{1}{4}$ yd. = $\frac{x}{8}$ yd. $3\frac{1}{4}$ yd. = $\frac{x}{16}$ yd.

Improper Fractions — Changing to Whole or Mixed Numbers

80. Are 13 fourths of pie more or less than a whole pie? Are they a fraction of a pie?

What is a fraction? See 62.

81. The fourths are equal parts of pies, and are called *fractional units.* Hence 13 fourths of pies is a *fractional number.* Write another fractional number which is equal to or greater than a whole.

82. Such a fractional number is called an *improper fraction.* A real fraction is less than the whole. Is the denominator of a real fraction greater, or less than the numerator?

83. Which of the fractions 3-fourths, 3-thirds, 7-fifths, $\frac{5}{9}$, and $\frac{7}{12}$ are improper fractions? Which real fractions?

Change to whole or mixed numbers:

84. 20 fourths of pie.

4 fourths = 1 pie, 20 fourths = x pies

85. 21 quarter dollars, 35 half dollars.

86. $\frac{32}{8}$ miles, $\frac{15}{4}$ tons.

87. $\frac{50}{8}$ in., $\frac{50}{16}$ in., $\frac{32}{4}$ in., $\frac{12}{2}$ in.

88. $\frac{9}{4}$ lb., $\frac{21}{2}$ lb., $\frac{43}{4}$ lb., $\frac{65}{4}$ lb.

89. $\frac{20}{2}$ pt., $\frac{31}{2}$ pt., $\frac{60}{8}$ pt., $\frac{65}{8}$ pt.

90. $\frac{20}{16}$ in., $\frac{24}{16}$ in., $\frac{32}{16}$ in., $\frac{40}{16}$ in.

91. $\$\frac{20}{10}$, $\$\frac{15}{10}$, $\$\frac{25}{10}$, $\$\frac{30}{10}$

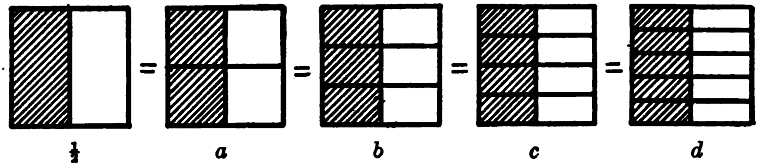
92. $\frac{9}{8}$, $\frac{8}{3}$, $\frac{7}{4}$, $\frac{6}{8}$, $\frac{6}{2}$, $\frac{8}{4}$, $\frac{10}{4}$

93.* If 1 answer out of 8 is correct, what part is correct?

94.* If 3 answers out of 8 are correct, what part is correct?

95.* If 15 answers out of 20 are correct, what part is correct?

Divided Halves



Look at these halves in answering the questions below, and drill upon the parts until you know them. Think the shaded parts as fractions.

96. In *a* the half is cut into 2 equal parts. How many such parts in the whole? What are these parts? Half of $\frac{1}{2} = x$, $\frac{1}{2} = \frac{x}{4}$

97. In *b* the half is cut into how many equal parts? How many such parts in the whole? What are these parts? A third of $\frac{1}{2} = x$, $\frac{2}{3}$ of $\frac{1}{2} = x$, $\frac{1}{2} = \frac{x}{6}$

98. In *c* the half is divided into how many equal parts? How many such parts in the whole? What are these parts? $\frac{1}{4}$ of $\frac{1}{2} = x$, $\frac{3}{4}$ of $\frac{1}{2} = x$, $\frac{1}{2} = \frac{x}{8}$

99. In *d* the half is divided into how many equal parts? How many such parts in the whole? What are they? $\frac{1}{5}$ of $\frac{1}{2} = x$, $\frac{2}{5}$ of $\frac{1}{2} = x$, $\frac{4}{5}$ of $\frac{1}{2} = x$, $\frac{1}{2} = \frac{x}{10}$

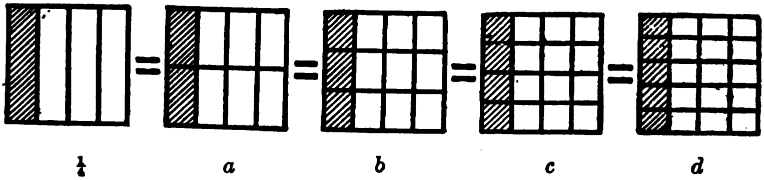
100. $\frac{1}{2} = \frac{x}{4}, \frac{x}{6}, \frac{x}{8}, \frac{x}{10}, \frac{x}{12}, \frac{x}{14}, \frac{x}{16}, \frac{x}{18}, \frac{x}{20}$

101. *With your eyes upon the squares above, think the changes indicated in* 100 *till you can give them without hesitating:*

102. $\frac{1}{2} + \frac{3}{8} = \frac{x}{8}$ $\frac{1}{2} + \frac{5}{8} = \frac{x}{8}$ $\frac{1}{2} - \frac{3}{8} = x$
103. $\frac{1}{2} \div \frac{1}{6} = x$ $\frac{1}{2} + \frac{1}{4} = x$
104. $\frac{1}{2} - \frac{8}{16} = x$ $\frac{8}{10} - \frac{1}{2} = x$ $\frac{5}{8} + \frac{1}{2} = x$
105. $\frac{3}{5}$ of $\frac{1}{2} = x$ $\frac{12}{16} - \frac{1}{2} = x$ $\frac{12}{16} \div \frac{1}{2} = x$
106.* Draw half of $\frac{1}{2}$. Draw two-thirds of $\frac{1}{2}$.

Draw ½ as shown above at the left. Divide each half into 2 equal parts. Then shade ½ of the shaded half by lines across the first shade lines.

Divided Fourths



107. What part of each square is shaded?

108. In *a* each fourth is divided into how many equal parts? How many such parts in the whole? What are these parts? Half of $\frac{1}{4} = x$, $\frac{1}{4} = \frac{x}{8}$

109. In *b* each fourth is divided into how many equal parts? How many such parts in the whole? What are these parts? A third of $\frac{1}{4} = x$, $\frac{2}{3}$ of $\frac{1}{4} = x$, $\frac{1}{4} = \frac{x}{12}$, $\frac{3}{4} = \frac{x}{12}$

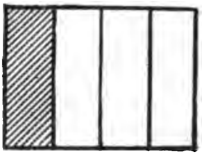
110. In *c* each fourth is divided into how many equal parts? How many such parts in the whole? What are these parts? A fourth of $\frac{1}{4} = x$, $\frac{3}{4}$ of $\frac{1}{4} = x$, $\frac{1}{4} = \frac{x}{16}$

111. In *d* the fourth is divided into how many equal parts? How many such parts in the whole? What are these parts? A fifth of $\frac{1}{4} = x$, $\frac{2}{5}$ of $\frac{1}{4} = x$, $\frac{4}{5}$ of $\frac{1}{4} = x$, $\frac{1}{4} = \frac{x}{20}$

112. $\frac{1}{4} = \frac{x}{8} = \frac{x}{12} = \frac{x}{16} = \frac{x}{20} = \frac{x}{24} = \frac{x}{28} = \frac{x}{32}$

With your eyes upon the squares above, think the changes indicated in 112 *until you can give them without hesitating:*

113.* Draw $\frac{1}{3}$ of $\frac{1}{4}$.



Draw $\frac{1}{4}$ as shown at the left. Divide each fourth into 3 equal parts. Then shade $\frac{1}{3}$ of the shaded fourth by lines across the first shade lines.

114.* Draw $\frac{3}{4}$ of $\frac{1}{2}$.

115. $\frac{2}{3}$ of $\frac{1}{4} = x$ $\qquad$ $\frac{1}{4} + \frac{5}{12} = x$

Think these exercises upon the squares in page 41 if you cannot think them apart.

116. $\frac{3}{4} = \frac{x}{12}$ $\qquad$ $\frac{1}{4}$ of $\frac{1}{4} = x$

117. $\frac{3}{4} = \frac{x}{16}$ $\qquad$ $\frac{3}{4} + \frac{3}{16} = x$

118. $\frac{3}{4} - \frac{8}{16} = x$ $\qquad$ $\frac{16}{20} - \frac{1}{4} = x$

119. $\frac{3}{4} + \frac{8}{20} = x$ $\qquad$ $\frac{3}{4} \div \frac{8}{20} = x$

120. Draw $\frac{1}{2}$ of $\frac{3}{4}$. What does it equal?

121. $\frac{1}{2} + \frac{5}{16} = x$ $\qquad$ $\frac{1}{2} - \frac{5}{16} = x$

122. $\frac{13}{16} - \frac{1}{2} = x$ $\qquad$ $\frac{7}{16} + \frac{1}{2} = x$

123. $\frac{11}{12} - \frac{1}{2} = x$ $\qquad$ $\frac{1}{2} - \frac{5}{12} = x$

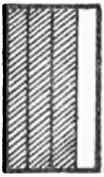
124. $\frac{11}{12} + \frac{1}{4} = x$ $\qquad$ $\frac{5}{12} + \frac{1}{4} = x$

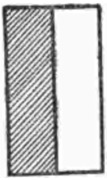
125. $\frac{3}{4} - \frac{3}{8} = x$ $\qquad$ $\frac{3}{4} + \frac{1}{8} = x$ $\qquad$ $\frac{1}{4} - \frac{1}{16} = x$

126. $\frac{3}{4} - \frac{5}{8} = x$ $\qquad$ $\frac{7}{8} - \frac{1}{8} = x$ $\qquad$ $\frac{1}{8} + \frac{3}{4} = x$

127. $\frac{7}{8} + \frac{1}{4} = x$ $\qquad$ $\frac{7}{8} - \frac{1}{4} = x$ $\qquad$ $\frac{7}{8} - \frac{3}{4} = x$

128. $\frac{9}{16} + \frac{1}{2} = x$ $\qquad$ $\frac{1}{2} - \frac{1}{16} = x$ $\qquad$ $\frac{1}{2} - \frac{7}{16} = x$





129. $\frac{1}{3}$ of $= x$ $\qquad$ $\frac{3}{5}$ of $= x$

130. $\frac{2}{3}$ of $= x$ $\qquad$ $\frac{1}{2}$ of $= x$

131. $\frac{1}{4}$ of $= x$ $\qquad$ $\frac{1}{4}$ of $= x$

132. $\frac{3}{4}$ of $= x$ $\qquad$ $\frac{3}{4}$ of $= x$

133. $\frac{1}{5}$ of $= x$ $\qquad$ $\frac{1}{5}$ of $= x$

134. $\frac{2}{3}$ of $\frac{1}{4} = x$ $\qquad$ $\frac{1}{4} + \frac{7}{12} = x$

135. $\frac{3}{8} + \frac{1}{4} = x$ $\qquad$ $\frac{3}{8} - \frac{1}{4} = x$

136. $\frac{1}{4} + \frac{5}{12} = x$ $\qquad$ $\frac{5}{12} - \frac{1}{4} = x$

137. $\frac{17}{20} - \frac{1}{4} = x$ $\qquad$ $\frac{17}{20} - \frac{3}{4} = x$

138. $\frac{17}{20} - \frac{1}{2} = x$ $\qquad$ $\frac{7}{20} + \frac{1}{2} = x$

139. $\frac{1}{2} - \frac{7}{20} = x$ $\qquad$ $\frac{3}{4} - \frac{1}{20} = x$

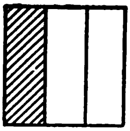
140. $\frac{11}{12} - \frac{1}{4} = x$ $\qquad$ $\frac{5}{12} + \frac{1}{4} = x$

141. $\frac{5}{8} - \frac{1}{2} = x$ $\qquad$ $\frac{1}{2} - \frac{3}{8} = x$

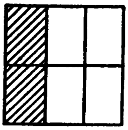
142. $\frac{5}{8} - \frac{5}{16} = x$ $\qquad$ $\frac{5}{8} + \frac{5}{16} = x$

143.* Draw $\frac{1}{2}$ of $\frac{3}{4}$.

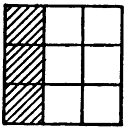
Parts of Thirds



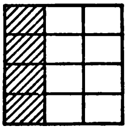
$\frac{1}{3}$



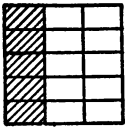
a



b



c



d

144. In *a* the third is divided into how many equal parts? How many such parts in the whole? What are these parts? Half of $\frac{1}{3} = x$, $\frac{1}{3} = \frac{x}{6}$, $\frac{2}{3} = \frac{x}{6}$

145. In *b* the third is divided into how many equal parts? How many such parts in the whole? What are these parts? A third of $\frac{1}{3} = x$, $\frac{2}{3}$ of $\frac{1}{3} = x$, $\frac{1}{3} = \frac{x}{9}$, $\frac{2}{3} = \frac{x}{9}$

146. In *c* the third is divided into how many equal parts? How many such parts in the whole? What are these parts? A fourth of $\frac{1}{3} = x$, $\frac{3}{4}$ of $\frac{1}{3} = x$, $\frac{1}{3} = \frac{x}{12}$, $\frac{2}{3} = \frac{x}{12}$

147. In *d* the third is divided into how many equal parts? How many such parts in the whole? What are these parts? A fifth of $\frac{1}{3} = x$, $\frac{2}{5}$ of $\frac{1}{3} = x$, $\frac{3}{5}$ of $\frac{1}{3} = x$, $\frac{4}{5}$ of $\frac{1}{3} = x$, $\frac{1}{3} = \frac{x}{15}$, $\frac{2}{3} = \frac{x}{15}$

148. $\frac{1}{3} + \frac{2}{9} = x$, $\frac{2}{3} + \frac{4}{9} = x$

Addition — Subtraction

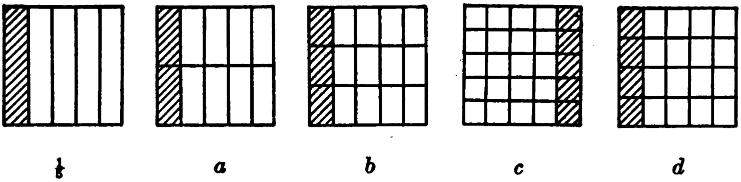
149. $\frac{1}{3} = \frac{x}{6}, \frac{x}{9}, \frac{x}{12}, \frac{x}{15}, \frac{x}{18}, \frac{x}{21}, \frac{x}{24}, \frac{x}{27}, \frac{x}{30}$

Drill upon the changes in 1 until you can give them promptly.

150. $\frac{1}{3} + \frac{1}{6} = x$ $\frac{1}{3} + \frac{1}{2} = x$ $\frac{1}{2} = \frac{x}{6}$
151. $\frac{1}{2} - \frac{1}{3} = x$ $\frac{2}{3} - \frac{1}{2} = x$ $\frac{1}{3} = \frac{x}{9}$
152. $\frac{1}{3} + \frac{1}{9} = x$ $\frac{2}{3} \div \frac{2}{9} = x$ $\frac{1}{3} = \frac{x}{12}$
153. $\frac{1}{3} + \frac{1}{12} = x$ $\frac{2}{3} - \frac{5}{12} = x$ $\frac{1}{4} = \frac{x}{12}$
154. $\frac{1}{3} + \frac{1}{4} = x$ $\frac{1}{3} - \frac{1}{4} = x$ $\frac{2}{3} = \frac{x}{15}$
155. $\frac{2}{3} + \frac{1}{15} = x$ $\frac{1}{3} - \frac{2}{15} = x$ $\frac{2}{3} = \frac{x}{18}$

156. $\frac{1}{3} - \frac{1}{18} = x$ $\frac{2}{3} + \frac{5}{18} = x$ $\frac{2}{3} = \frac{x}{21}$
157. $\frac{1}{3} + \frac{8}{21} = x$ $\frac{2}{3} - \frac{11}{21} = x$ $\frac{2}{3} = \frac{x}{24}$
158. $\frac{1}{3} - \frac{5}{24} = x$ $\frac{1}{3} + \frac{13}{24} = x$ $\frac{2}{3} = \frac{x}{30}$
159. $\frac{1}{2} - \frac{1}{30} = x$ $\frac{2}{3} + \frac{1}{30} = x$ $\frac{2}{3} + \frac{1}{4} = x$
160. $\frac{1}{3} + \frac{1}{6} = x$ $\frac{2}{3} - \frac{1}{6} = x$ $\frac{5}{6} - \frac{1}{3} = x$
161. $\frac{2}{3} + \frac{1}{12} = x$ $\frac{1}{3} + \frac{7}{12} = x$ $\frac{7}{12} - \frac{1}{3} = x$
162. $\frac{2}{3} - \frac{1}{9} = x$ $\frac{5}{9} - \frac{1}{3} = x$ $\frac{7}{9} - \frac{2}{3} = x$

Divided Fifths



163. In *a* the fifth is divided into how many equal parts? How many such parts in the whole? What are these parts? Half of $\frac{1}{5} = x$, $\frac{1}{5} = \frac{x}{10}$, $\frac{2}{5} = \frac{x}{10}$, $\frac{3}{5} = \frac{x}{10}$, $\frac{4}{5} = \frac{x}{10}$

164. In *b* the fifth is divided into how many equal parts? How many such parts in the whole? What are these parts? $\frac{1}{3}$ of $\frac{1}{5} = x$, $\frac{1}{5} = \frac{x}{15}$, $\frac{2}{5} = \frac{x}{15}$, $\frac{3}{5} = \frac{x}{15}$, $\frac{4}{5} = \frac{x}{15}$

165. In *c* the fifth is divided into how many equal parts? How many such parts in the whole? What are these parts? $\frac{1}{4}$ of $\frac{1}{5} = x$, $\frac{3}{4}$ of $\frac{1}{5} = x$, $\frac{1}{5} = \frac{x}{20}$, $\frac{2}{5} = \frac{x}{20}$, $\frac{3}{5} = \frac{x}{20}$, $\frac{4}{5} = \frac{x}{20}$

166. In *d* the fifth is divided into how many equal parts? How many such parts in the whole? What are these parts? $\frac{1}{5}$ of $\frac{1}{5} = x$, $\frac{2}{5}$ of $\frac{1}{5} = x$, $\frac{3}{5}$ of $\frac{1}{5} = x$, $\frac{4}{5}$ of $\frac{1}{5} = x$, $\frac{1}{5} = \frac{x}{25}$, $\frac{2}{5} = \frac{x}{25}$, $\frac{3}{5} = \frac{x}{25}$, $\frac{4}{5} = \frac{x}{25}$

167. $\frac{1}{5} = \frac{x}{10}, \frac{x}{15}, \frac{x}{20}, \frac{x}{25}, \frac{x}{30}, \frac{x}{35}, \frac{x}{40}$

Drill upon the changes in 5 until you can give them promptly.

168. What are the largest like parts into which thirds and fifths can be divided?

169. $\frac{1}{3} = \frac{x}{15}$, $\frac{1}{5} = \frac{x}{15}$ *Remember this.*

170. $\frac{1}{3} + \frac{2}{15} = x$ $\frac{1}{3} - \frac{2}{15} = x$ $\frac{1}{5} + \frac{1}{15} = x$

171. $\frac{1}{5} - \frac{1}{15} = x$ $\frac{1}{3} + \frac{1}{5} = x$ $\frac{1}{3} - \frac{1}{5} = x$

172. $\frac{2}{3} - \frac{4}{15} = x$ $\frac{11}{15} - \frac{1}{3} = x$ $\frac{13}{15} - \frac{4}{5} = x$

173. What are the largest parts into which halves and fifths can be divided?

174. $\frac{1}{2} = \frac{x}{10}$ $\frac{1}{5} = \frac{x}{10}$ *Remember this.*

175. $\frac{1}{2} = \frac{x}{10}$ $\frac{1}{5} = \frac{x}{10}$ $\frac{1}{2} + \frac{1}{5} = x$

176. $\frac{1}{2} - \frac{1}{5} = x$ $\frac{1}{2} + \frac{2}{5} = x$ $\frac{3}{5} - \frac{1}{2} = x$

177. What are the largest parts into which fourths and fifths can be divided?

178. $\frac{1}{4} = \frac{x}{20}$ $\frac{1}{5} = \frac{x}{20}$ *Remember this.*

179. $\frac{1}{4} + \frac{1}{5} = x$ $\frac{3}{4} - \frac{1}{5} = x$ $\frac{3}{4} - \frac{2}{5} = x$

180. $\frac{1}{2} + \frac{1}{5} = x$ $\frac{1}{2} - \frac{2}{5} = x$ $\frac{2}{3} + \frac{1}{5} = x$

181. $\frac{1}{3} + \frac{3}{5} = x$ $\frac{2}{3} + \frac{1}{5} = x$ $\frac{4}{5} - \frac{1}{2} = x$

182. $\frac{1}{4} + \frac{1}{5} = x$ $\frac{1}{4} - \frac{1}{5} = x$ $\frac{3}{4} - \frac{3}{5} = x$

183. $\frac{2}{3} + \frac{1}{2} = x$ $\frac{2}{3} - \frac{1}{2} = x$ $\frac{2}{3} - \frac{3}{5} = x$

184. $\frac{1}{4} \div \frac{1}{5} = x$ $\frac{1}{3} \div \frac{1}{4} = x$ $\frac{1}{2} \div \frac{1}{3} = x$

Change to like parts, and then divide.

185. $\frac{1}{3} + \frac{1}{5} = x$ $\frac{1}{3} - \frac{1}{5} = x$ $\frac{2}{3} + \frac{1}{5} = x$

186. $\frac{2}{3} - \frac{1}{5} = x$ $\frac{2}{3} \div \frac{1}{5} = x$ $\frac{2}{5} \div \frac{1}{3} = x$

187. $\frac{2}{3} + \frac{2}{5} = x$ $\frac{2}{3} - \frac{2}{5} = x$ $\frac{4}{5} - \frac{1}{3} = x$

188. $\frac{4}{5} - \frac{2}{3} = x$ $\frac{2}{3} - \frac{3}{5} = x$ $\frac{1}{2} - \frac{2}{5} = x$

189. $\frac{1}{4}$ of $\frac{1}{5} = x$ $\frac{1}{4}$ of $\frac{3}{5} = x$ $\frac{3}{4}$ of $\frac{3}{5} = x$

190. $\frac{1}{2}$ of $\frac{3}{5} = x$ $\frac{1}{2}$ of $\frac{4}{5} = x$ $\frac{1}{2}$ of $\frac{2}{5} = x$

191. $\frac{1}{3}$ of $\frac{2}{5} = x$ $\frac{1}{3}$ of $\frac{3}{5} = x$ $\frac{2}{3}$ of $\frac{4}{5} = x$

192. $\frac{1}{4}$ of $\frac{2}{5} = x$ $\frac{1}{4}$ of $\frac{3}{5} = x$ $\frac{3}{4}$ of $\frac{3}{5} = x$

193. $\frac{1}{5}$ of $\frac{2}{5} = x$ $\frac{2}{5}$ of $\frac{2}{5} = x$ $\frac{4}{5}$ of $\frac{2}{5} = x$

194.* $\frac{4}{3} \div \frac{2}{5} = x$ $\frac{2}{5} + \frac{4}{3} = x$

195.* $\frac{3}{4} - \frac{1}{3} = x$ $\frac{3}{4} - \frac{1}{5} = x$

Divided Parts — Larger Terms

In answering the following questions look at the squares showing divided halves and fourths if necessary.

196. When half is divided into 2 equal parts, there are how many such parts in the whole? The number of parts in the whole becomes how many times as great as before?

197. This makes the numerator and denominator how many times as great?

198. When $\frac{1}{2}$ is divided into 3 equal parts, the numerator and denominator become how many times as great? $\frac{1}{2} = \frac{3}{6}$

199. When fourths are each divided into 5 equal parts, the numerator and denominator become how many times as great? They are multiplied by what? $\frac{3}{4} = \frac{15}{20}$, $\frac{3 \times 5}{4 \times 5} = \frac{15}{20}$

200. Does multiplying both terms by the same number make them express a larger fraction, a smaller fraction, or one just as large as they expressed before?

To express a fraction in larger terms, multiply both terms by the same number.

201. By what number must the terms of $\frac{2}{3}$ be multiplied to express the fraction as twelfths? To express it as eighteenths? As twenty-fourths? As thirtieths?

202. $\frac{2}{3} = \frac{x}{12}, \frac{x}{18}, \frac{x}{24}, \frac{x}{30}$

203. By what must the terms of $\frac{3}{5}$ be multiplied to express the fraction as tenths? To express it as fifteenths? As twentieths?

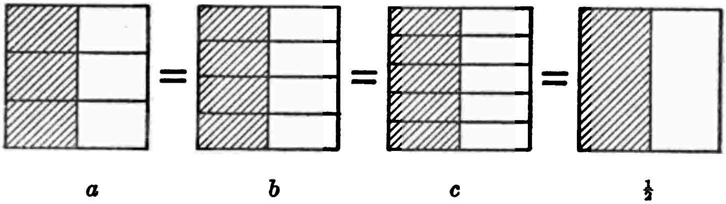
204. $\frac{3}{5} = \frac{x}{10}, \frac{x}{15}, \frac{x}{20}$

205. By what must the terms of $\frac{3}{4}$ be multiplied to express the fraction as twelfths? To express it as sixteenths? As twentieths?

206. $\frac{3}{4} = \frac{x}{12}, \frac{x}{16}, \frac{x}{20}, \frac{x}{24}, \frac{x}{28}, \frac{x}{32}$

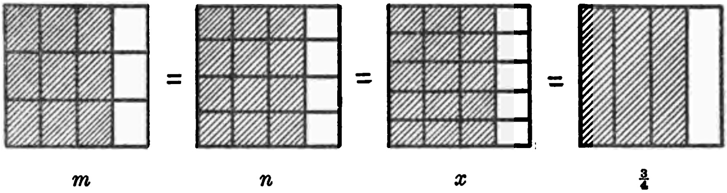
207. $\frac{7}{8} = \frac{x}{16}, \frac{x}{24}, \frac{x}{32}, \frac{x}{40}, \frac{x}{48}, \frac{x}{64}$

United parts — Smaller Terms



208. Think of the 3 shaded sixths in *a* as united into 1 part. They form what part of the square? The number of parts has become what part as large as before? $\frac{3}{6} = \frac{1}{2}$. The numerator and denominator have become what part as large?

209. Think of the 4 shaded eighths in *b* as united into 1 part. They form what part of the square? The number of parts has become what part as large? $\frac{4}{8} \div \frac{4}{4} = \frac{1}{2}$. The numerator and denominator have each been divided by what?



210. How many equal parts in the whole of *x*? The shaded parts of *x* are what fraction of the whole? Think of the 5 shaded twentieths in each vertical row as united into 1 part. They form what part of the square? The number of parts has become what part as large? $\frac{15}{20} \div \frac{5}{5} = \frac{3}{4}$. The numerator and denominator have each been divided by what?

211. Does dividing both terms of a fraction by the same number make them express a larger fraction, a smaller fraction, or one just as large as they expressed before?

212. To express a fraction in smaller terms, divide both terms by the same number. To express it in its smallest terms, keep on dividing as long as any number will divide both terms without remainder.

213. By what number must the terms of $\frac{12}{16}$ be divided to express the fraction as fourths? $\frac{12}{16} = x$ fourths.

214. By what number must the terms of $\frac{9}{12}$ be divided to express the fraction as fourths? See *m*. $\frac{9}{12} = \frac{x}{4}$.

215. $\frac{9}{15} = \frac{x}{5}$, $\frac{15}{24} = \frac{x}{8}$, $\frac{16}{24} = \frac{x}{8}$

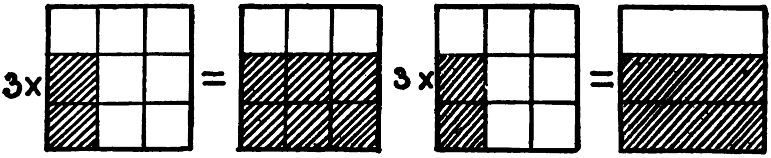
216. Express $\frac{5}{10}$, $\frac{8}{20}$, $\frac{20}{24}$, $\frac{10}{80}$, and $\frac{9}{12}$ in smallest terms.

217. Express in smallest terms $\frac{7}{28}$, $\frac{18}{24}$, $\frac{15}{25}$, $\frac{12}{18}$, and $\frac{15}{18}$.

218. $\frac{10}{20}$, $\frac{15}{20}$, $\frac{16}{20}$, $\frac{12}{20}$, $\frac{4}{20}$, $\frac{18}{20}$, $\frac{8}{18}$, $\frac{9}{18}$, $\frac{6}{18}$, $\frac{12}{18}$

To Multiply a Fraction by a Whole Number

219. What fraction is shown in the square at the left?



$3 \times \frac{2}{9} = \frac{6}{9}$ $\qquad$ $\frac{2}{9 \div 3} = \frac{2}{3}$

220. What is its numerator?

221. If the numerator is multiplied by 3, how is the value of the fraction affected? The fraction has been multiplied by what? What does 3 times $\frac{2}{9}$ equal?

222. What fraction is shown in the third square?

223. What is its denominator?

224. If the denominator (the number of parts in the whole) is divided by 3, there are then how many parts in the whole? What are these parts?

225. These parts are shown in the fourth square. They are how many times as large as before dividing the denominator? The fraction has been made how many times as great? It has been multiplied by what? What is the product?

226. How do the two products $\frac{6}{9}$ and $\frac{2}{3}$ compare in value?

227. Which is the simpler? Which is the better method, multiplying the numerator or dividing the denominator?

228. $5 \times \frac{2}{15} = x \quad 4 \times \frac{3}{20} = x \quad 3 \times \frac{7}{9} = x \quad 8 \times \frac{8}{16} = x$

229. $2 \times \frac{3}{8} = x \quad 2 \times \frac{5}{12} = x \quad 3 \times \frac{4}{15} = x \quad 3 \times \frac{2}{5} = x$

To multiply a fraction by a whole number, divide the denominator if possible; otherwise multiply the numerator.

230. $5 \times \frac{3}{4}$ in. $= x \quad 7 \times \frac{5}{12}$ in. $= x \quad 5 \times \frac{7}{10}$ in. $= x$

Change improper fractions in answers to whole or mixed numbers.

231. $9 \times \frac{2}{16}$ in. $= x \quad 4 \times \frac{7}{8}$ yd. $= x \quad 5 \times \frac{7}{8}$ in. $= x$

232. $4 \times \frac{11}{16}$ lb. $= x \quad 8 \times \frac{1}{16}$ lb. $= x \quad 5 \times \frac{11}{16}$ lb. $= x$

233. $3 \times \frac{7}{16}$ in. $= x \quad 3 \times \frac{5}{16}$ in. $= x \quad 9 \times \frac{2}{3}$ ft. $= x$

234. $3 \times \frac{2}{9}$ yd. $= x \quad 5 \times \frac{4}{9}$ yd. $= x \quad 6 \times \frac{5}{12}$ ft. $= x \quad 8 \times \frac{5}{32}$ in. $= x$

235. $9 \times \frac{7}{12}$ ft. $= x \quad 4 \times \frac{7}{12}$ ft. $= x \quad 3 \times \frac{5}{32}$ in. $= x \quad 16 \times \frac{8}{32}$ in. $= x$

236. How wide a floor will 6 strips of carpeting each $\frac{3}{4}$ yd. wide cover?

237. How wide a floor would 8 strips lay? How wide would 5 strips lay?

238. Find the cost of 8 shovels @ \$$\frac{4}{5}$ each.

239. How wide a floor would 60 boards each $\frac{1}{6}$ ft. wide lay?

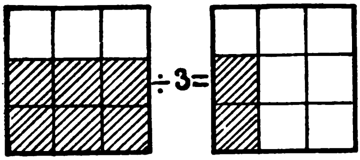
240.* $6 \times \frac{5}{36}$ yd. $= x \quad 8 \times \frac{5}{36}$ yd. $= x \quad 9 \times \frac{5}{32}$ yd. $= x$

241.* $16 \times \frac{1}{32}$ in. $= x \quad 9 \times \frac{8}{32}$ in. $= x \quad 12 \times \frac{7}{24}$ in. $= x$

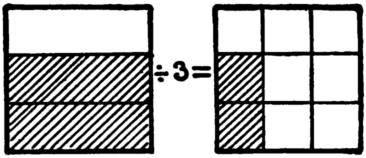
242.* Find the cost of 20 yards of cloth @ $\frac{3}{4}$ of a dollar a yard.

Division of a Fraction by a Whole Number

243. What fraction is shown in the square at the left?



$\frac{6 \div 3}{9} = \frac{2}{9}$



$\frac{2}{3 \times 3} = \frac{2}{9}$

244. What is its numerator? If the numerator (the number of parts in the fraction) is divided by 3, it becomes what? The fraction becomes what? The fraction has been divided by what? $\frac{6}{9} \div 3 = x$

245. What fraction is shown in the third square? How does this compare with $\frac{6}{9}$ in value? Can its numerator be divided by 3 without remainder? What is its denominator?

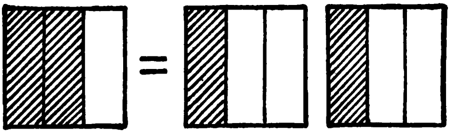
246. If the number of parts in the whole (the denominator) is multiplied by 3, it becomes what? The fraction becomes what? This is what part as great as $\frac{2}{3}$?

247. Multiplying the denominator by 3 divides the fraction by what?

To divide a fraction by a whole number, divide the numerator if possible without remainder; otherwise, multiply the denominator.

248. $\frac{4}{9}$ yd. $\div 2 = x$ $\frac{4}{9}$ yd. $\div 3 = x$ $\frac{9}{16}$ in. $\div 3 = x$
249. $\frac{3}{8}$ in. $\div 5 = x$ $\frac{3}{8}$ in. $\div 3 = x$ $\frac{15}{16}$ in. $\div 5 = x$
250. $\frac{15}{16}$ in. $\div 4 = x$ $\frac{7}{8}$ yd. $\div 7 = x$ $\frac{7}{8}$ yd. $\div 4 = x$
251. $\frac{3}{4}$ d. $\div 3 = x$ $\frac{2}{3}$ yd. $\div 3 = x$ $\frac{1}{3}$ h. $\div 4 = x$
252. $\frac{5}{6}$ in. $\div 4 = x$ $\frac{5}{8}$ in. $\div 5 = x$ $\frac{5}{16}$ in. $\div 6 = x$
$\frac{5}{2}$ in. $\div 3 = x$
253. $\frac{5}{8} \div 3 = x$ $\frac{8}{9} \div 4 = x$ $12\frac{3}{4} \div 3 = x$
254. $\frac{7}{9} \div 5 = x$ $\$21\frac{3}{4} \div 3 = x$ $30\frac{5}{8}$ in. $\div 5 = x$

Fraction of Whole Number



$\frac{2}{3}$ of 1 = $\frac{1}{3}$ of 2

255. $\frac{4}{5}$ of 25¢ $= 4 \times \frac{1}{5}$ of 25¢ $= x$ $\frac{3}{4}$ of 20 in. $= 3 \times \frac{1}{4}$ of 20 in. $= x$

256. $\frac{5}{8}$ of 2 mi. $= \frac{1}{8}$ of 5×2 mi. $= x$ $\frac{3}{7}$ of 8 d. $= \frac{1}{7}$ of 3×8 d. $= x$

257. $\frac{2}{3}$ of 12 in. $= x$ in., $\frac{2}{3}$ of 11 in. $= x$ in.

258. In the above we may find 2 times $\frac{1}{3}$ of the number, or $\frac{1}{3}$ of 2 times the number. Which is the easier way to find $\frac{2}{3}$ of 12 in.? Why?

259. Which is the easier way to find $\frac{2}{3}$ of 11 in.? Why?

In both cases we *divide by the denominator* of the fraction and *multiply by the numerator.* In one case *we divide first,* and in the other we *multiply first.*

260. $\frac{4}{5}$ of 12 lb. $= x$ $\frac{4}{5}$ of 30 lb. $= x$ $\frac{5}{7}$ of 20 d. $= x$

Use the easier way for each part.

261. $\frac{5}{7}$ of 28 $= x$ $\frac{3}{4}$ of \$48 $= x$ $\frac{3}{4}$ of \$15 $= x$

262. $4 \times \frac{2}{3} = x$ $\frac{2}{3}$ of $4 = x$ $4 \times \frac{2}{3} = \frac{2}{3}$ of 4

A number times a fraction equals the fraction of the number.

263. $\frac{3}{4}$ of \$$\frac{4}{5}$ $= x$ dollars $\frac{3}{4}$ of \$$\frac{2}{3}$ $= x$ dollars

264. How much will $\frac{2}{3}$ yd. of velvet cost @ \$6.75?

Fraction of a Fraction

265. $\frac{3}{4}$ of $\frac{8}{9} = 3 \times \frac{1}{4}$ of $\frac{8}{9} = x$ $\frac{2}{5}$ of $\frac{10}{11} = 2 \times \frac{1}{5}$ of $\frac{10}{11} = x$

266. $\frac{6}{7}$ of $\frac{14}{15} = 6 \times \frac{1}{7}$ of $\frac{14}{15} = x$ $\frac{5}{8}$ of $\frac{24}{25} = 5 \times \frac{1}{8}$ of $\frac{24}{25} = x$

267. $\frac{2}{3}$ of $\frac{4}{5} = \frac{1}{3}$ of $2 \times \frac{4}{5} = x$ $\frac{3}{4}$ of $\frac{7}{8} = \frac{1}{4}$ of $3 \times \frac{7}{8} = x$

268. $\frac{3}{7}$ of $\frac{2}{9} = \frac{1}{7}$ of $3 \times \frac{2}{9} = x$ $\frac{8}{9}$ of $\frac{2}{3} = \frac{1}{9}$ of $8 \times \frac{2}{3} = x$

Proceed as in finding a fraction of a whole number. But in these exercises we have a fraction to divide by the denominator. In what two ways may a fraction be divided by a whole number? In each case use the easier way.

269. $\frac{2}{3}$ of $\frac{3}{4}$ in. $= x$ in., $\frac{2}{3}$ of $\frac{9}{10}$ m. $= x$ m.
How do you find $\frac{1}{3}$ of the fraction here?

270. $\frac{4}{5}$ of $\frac{15}{16}$ in. $= x$ in., $\frac{3}{5}$ of $\frac{15}{32}$ in. $= x$ in.

271. $\frac{3}{4}$ of $\frac{5}{6}$ ft. $= x$ ft., $\frac{3}{4}$ of $\frac{3}{8}$ in. $= x$ in.

272. In exercise 271, did you find $\frac{1}{4}$ of the fraction by dividing the numerator, or by multiplying the denominator?

273. Having $\frac{1}{4}$ of the fraction, how can $\frac{3}{4}$ be found?

In finding the fraction of the fraction in this case we have *multiplied the denominators together for the denominator*, and *the numerators for the numerator, of the result.* The result may always be obtained in that way.

274. $\frac{2}{3}$ of $\frac{13}{15}$ h. $= x$ h., $\frac{2}{3}$ of $\frac{9}{10}$ h. $= x$ h.

275. What is the best way of thinking the second part of exercise 274?

276. $\frac{5}{8}$ of $\frac{1}{2}$ in. $= x$ in. $\frac{7}{8}$ of $\frac{3}{4}$ in. $= x$ in.

277. $\frac{5}{7}$ of $\frac{3}{5}$ d. $= x$ d. $\frac{2}{9}$ of $\frac{3}{4}$ h. $= x$ h.

278. $\frac{3}{8}$ of $\frac{3}{4}$ in. $= x$ in. $\frac{5}{8}$ of $\frac{1}{2}$ in. $= x$ in.

Review

279. $\frac{3}{5}$ of $\frac{6}{10} = x$ $\frac{3}{4}$ of $\frac{5}{12} = x$ $\frac{2}{3}$ of $\frac{6}{9} = x$

280. $\frac{5}{6}$ of 36 in. $= x$ $\frac{3}{5}$ of 12 in. $= x$ $\frac{3}{8}$ of 12 in. $= x$

281. 4 × $\frac{7}{8}$ in. $= x$ 5 × $\frac{7}{8}$ in. $= x$ 9 × $\frac{3}{8}$ in. $= x$

282. $\frac{3}{4} + \frac{6}{10} = x$ $\frac{3}{8} - \frac{1}{3} = x$ $\frac{4}{5} + \frac{1}{4} = x$ $2\frac{1}{4}$ in. − $\frac{5}{8}$ in. $= x$

283. $\frac{2}{5} = \frac{x}{25}$, $\frac{1}{6} = \frac{x}{30}$, $\frac{2}{3} = \frac{x}{60}$, $\frac{5}{6} = \frac{x}{36}$

284. Fred answered 8 questions out of 10 correctly. What part was correct?

285.* George lives $\frac{3}{4}$ mi. and Sam $1\frac{1}{3}$ mi. east of the post office. How far apart do they live?

Multiplication of Mixed Number by Whole Number

286. $3 \times 4\frac{1}{2}$ in. $= x$ $5 \times 6\frac{1}{3}$ yd. $= x$ $4 \times 6\frac{2}{3}$ yd. $= x$

To multiply a mixed number by a whole number, **multiply the entire part and the fraction separately, and add the products.**

287. $4 \times 6\frac{2}{3}$ yd. $= x$ yd. $8 \times 5\frac{3}{4}$ lb. $= x$ lb.
288. $5 \times 2\frac{3}{4}$ min. $= x$ min. $5 \times 4\frac{3}{8}$ mi. $= x$ mi.
289. Find the area of a rectangle $6\frac{1}{2}$ in. by 5 in.?
290. Find the cost of 6 barrels of apples @ \$2.75 (\$$2\frac{3}{4}$).
291. Of 8 tons of coal @ \$7.25 per ton.
292. Of 6 boxes of oranges @ \$2.75.
293. Of 4 barrels of potatoes @ \$4.50.

Change the following numbers as indicated:

294. *To inches,* $2\frac{1}{2}$ ft., $1\frac{2}{3}$ ft., $6\frac{1}{4}$ ft., $12\frac{1}{2}$ ft.
295. *To ounces,* $1\frac{1}{2}$ lb., $2\frac{1}{4}$ lb., $10\frac{1}{8}$ lb., $5\frac{3}{8}$ lb., $10\frac{5}{8}$ lb.
296. *To pints,* $6\frac{1}{2}$ qt., $3\frac{1}{4}$ qt., $2\frac{1}{4}$ gal., $1\frac{1}{8}$ gal., $1\frac{3}{8}$ pk.

Fraction of Mixed Number

297. $\frac{3}{4}$ of $4\frac{1}{2}$ in. $= x$ in. $\frac{2}{5}$ of $15\frac{1}{4}$ in. $= x$ in.
$\frac{3}{4}$ of 4 in. $= x$ in. $\frac{3}{4}$ of $\frac{1}{2}$ in. $= x$ in. 3 in. $+ \frac{3}{8}$ in. $= x$ in.
298. $\frac{2}{3}$ of $9\frac{3}{4}$ min. $= x$ min. $\frac{2}{3}$ of $12\frac{1}{2}$ min. $= x$ min.

How did you find the fractions of the mixed numbers in 297 and 298?

299. $\frac{2}{5}$ of $4\frac{1}{2}$ in. $= x$ in. $\frac{1}{6}$ of $8\frac{1}{2}$ in. $= x$ in.

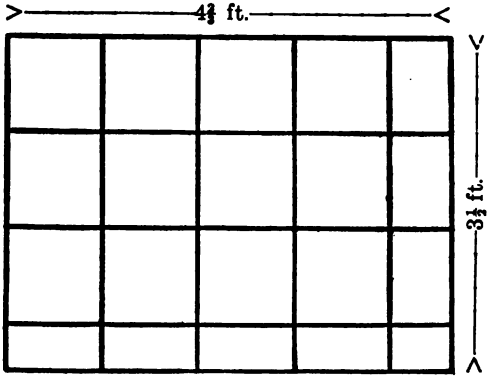
$$4\frac{1}{2} = \frac{x}{2} \quad \frac{1}{5} \text{ of } \frac{9}{2} = \frac{9}{x} \quad \frac{2}{5} \text{ of } \frac{9}{2} = \frac{x}{10} \quad \frac{18}{10} = x$$

300. $\frac{3}{4}$ of $3\frac{2}{3}$ yd. $= x$ yd. $\frac{3}{7}$ of $7\frac{1}{2} = x$

Find the fraction of the whole number and the fraction separately and add these results, if not too difficult. Otherwise, change to an improper fraction, and find the fraction of this.

301. $\frac{2}{3}$ of $6\frac{3}{4}$ yd. $= x$ $\qquad$ $\frac{2}{5}$ of $\$8\frac{1}{2}$ $= x$
302. $\frac{6}{7}$ of $7\frac{1}{2}$ rd. $= x$ $\qquad$ $\frac{2}{7}$ of $14\frac{2}{3}$ yd. $= x$
303. $\frac{1}{3}$ of $6\frac{1}{2}$ ft. $= x$ $\qquad$ $\frac{2}{3}$ of $7\frac{1}{4}$ ft. $= x$
304. $\frac{3}{8}$ of $1\frac{1}{3}$ yd. $= x$ $\qquad$ $\frac{3}{4}$ of $1\frac{1}{3}$ yd. $= x$
305. $\frac{3}{4}$ of $1\frac{2}{3}$ yd. $= x$ $\qquad$ $\frac{1}{2}$ of $1\frac{2}{3}$ yd. $= x$
306. $\frac{5}{8}$ of $8\frac{2}{3}$ yd. $= x$ yd. $\frac{3}{8}$ of $2\frac{3}{4}$ lb. $= x$ lb.

Multiplication of a Mixed Number by a Mixed Number



307. How many square feet form 1 whole row the longer way of this rug?

308. How many such whole rows in the rug? What part of another row?

309. How many square feet in the 3 rows?

$3 \times 4\frac{2}{3}$ sq. ft. $= x$

310. How many in the half row? $\frac{1}{2}$ of $4\frac{2}{3}$ sq. ft. $= x$

311. How many in the whole rug? 14 sq. ft. + $2\frac{1}{3}$ sq. ft. $= x$

312. The floor of a closet is $6\frac{1}{2}$ ft. by $2\frac{1}{2}$ ft. How many square feet in one whole row the longer way? How many rows in the whole floor?

313. How many square feet in the 2 rows? In the half row? In the whole floor?

314. $2 \times 6\frac{1}{2}$ sq. ft. $= x$ $\qquad$ $\frac{1}{2}$ of $6\frac{1}{2}$ sq. ft. $= x$ $\qquad$ 13 sq. ft. + $3\frac{1}{4}$ sq. ft. $= x$ sq. ft.

315. How many square feet in one whole row the longer way of a rug $6\frac{2}{3}$ ft. by $3\frac{1}{2}$ ft.? How many such rows in the rug? How many square feet in the 3 rows? In the half row? In all?

316. $2\frac{1}{2} \times 4\frac{3}{4}$ ft. $= x$ ft.
$2 \times 4\frac{3}{4}$ ft. $= x$ ft. $\frac{1}{2}$ of $4\frac{3}{4}$ ft. $= x$ ft. $9\frac{1}{2}$ ft. $+$ $2\frac{3}{8}$ ft. $= x$ ft.

To multiply a mixed number by a mixed number, multiply by the entire part of the multiplier, find the fractional part indicated in the multiplier, and add the two results.

317. How many square rods in a lot of land $6\frac{3}{4}$ rd. long and 3 rd. wide? In one $6\frac{3}{4}$ rd. by $\frac{2}{3}$ rd.? In one $6\frac{3}{4}$ rd. by $3\frac{2}{3}$ rd.?

318. Find the cost of 8 tons of coal @ \$$6\frac{3}{4}$. Of $\frac{1}{2}$ ton. Of $8\frac{1}{2}$ tons.

319. Of 6 tons of hay @ \$$16\frac{1}{2}$. Of $\frac{1}{4}$ ton. Of $6\frac{1}{4}$ tons.

320. Of 16 yd. of carpeting @ \$$1\frac{1}{8}$. Of $\frac{1}{2}$ yd. Of $16\frac{1}{2}$ yd.

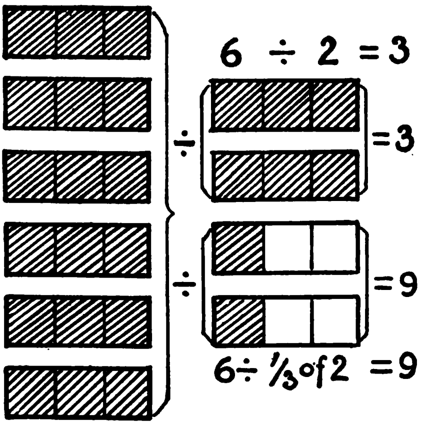
Division — Mixed Number by Whole Number

321. $8 \div 4 = x$ $\frac{1}{2} \div 4 = x$ $8\frac{1}{2} \div 4 = x$
322. $8 \div 4 = x$ $1\frac{1}{2} = \frac{x}{2} \div 4 = \frac{8}{x}$ $9\frac{1}{2} \div 4 = x$
323. $18 \div 6 = x$ $2\frac{2}{3} = \frac{x}{8} \div 6 = \frac{8}{x}$ $20\frac{2}{3} \div 6 = x$

To divide a mixed number by a whole number, divide the entire part of the mixed number; if there is a remainder, change that and the fraction to an improper fraction, and divide the fraction.

324. $16\frac{1}{4} \div 5 = x$ $22\frac{1}{2} \div 4 = x$ $27\frac{2}{3} \div 3 = x$
325. $16\frac{2}{3} \div 5 = x$ $21\frac{1}{2} + 5 = x$ $26\frac{1}{4} \div 5 = x$
326. $42\frac{3}{4} \div 6 = x$ $37\frac{1}{2} \div 7 = x$ $37\frac{1}{2} \div 5 = x$
327. $24\frac{3}{8} \div 5 = x$ $65\frac{1}{3} \div 6 = x$ $49\frac{1}{2} \div 6 = x$
328. $32\frac{5}{6} \div 8 = x$ $122\frac{1}{2} \div 8 = x$ $41\frac{2}{3} \div 7 = x$
329. $39\frac{1}{3}$ m. $= x$ years $62\frac{1}{2}$ m. $= x$ years
330. $32\frac{1}{2}$ oz. $= x$ pounds $65\frac{1}{3}$ oz. $= x$ pounds
331. $25\frac{1}{3}$ in. $= x$ feet $13\frac{1}{3}$ in. $= x$ feet
332. $27\frac{1}{2}$ qt. $= x$ gallons $12\frac{3}{4}$ pt. $= x$ quarts

Division by a Fraction



333. How many rectangles in the tier at the left? How many in the upper group at the right? The shaded parts of the lower group are what part of how many?

334. $\frac{1}{3}$ of 2 is called second view of $\frac{2}{3}$. Write the second view of $\frac{3}{4}$, $\frac{2}{5}$, $\frac{5}{6}$, $\frac{6}{7}$, $\frac{7}{8}$, and $\frac{8}{9}$.

335. $6 \div \frac{2}{3} = x$

$6 \div 2 = x \quad 6 \div \frac{1}{3} \text{ of } 2 = 3 \times 3 = x$

336. $8 \div \frac{4}{5} = x$

To divide by a fraction, divide by the numerator and multiply the result by the denominator.

337. $10 \div \frac{2}{3} = x \qquad 8 \div \frac{2}{3} = x \qquad 12 \div \frac{2}{3} = x$

338. $12 \div \frac{3}{4} = x \qquad 18 \div \frac{3}{5} = x \qquad 6 \div \frac{3}{7} = x$

339. $8 \div \frac{3}{5} = x$

$8 \div 3 = \frac{8}{3} \quad 8 \div \frac{1}{5} \text{ of } 3 = 5 \times \frac{8}{3} = \frac{40}{3} = 13\frac{1}{3}$

340. $7 \div \frac{2}{3} = x \quad 9 \div \frac{4}{5} = x \quad 8 \div \frac{5}{6} = x \quad 5 \div \frac{3}{4} = x$

341. $12 \div \frac{7}{10} = x \quad 15 \div \frac{5}{8} = x \quad 11 \div \frac{3}{4} = x \quad 13 \div \frac{3}{5} = x$

342. $12 \div \frac{3}{4} = x \quad 8 \div \frac{3}{5} = x \quad 6 \div \frac{3}{5} = x$

343. $12 \div \frac{6}{7} = x \quad 10 \div \frac{4}{5} = x \quad 3 \div \frac{4}{5} = x$

344. Dividing by 6 in the first part of the above is finding what part of 12? Multiplying this sixth by 7 is finding what part of 12? **The dividing a number by $\frac{6}{7}$ is the same as finding $\frac{7}{6}$ of the number.** Dividing by $\frac{2}{3}$ is the same as finding what? Dividing by $\frac{3}{4}$ is the same as what?

It is sometimes convenient in written work to invert a fractional divisor and consider it a multiplier.

345. $8 \div \frac{3}{8} = x \quad 10 \div \frac{3}{16} = x \quad 10 \div \frac{4}{7} = x$

Division of a Fraction by a Fraction

346. $\frac{4}{5} \div \frac{2}{7} = x$
$\frac{4}{5} \div 2 = \frac{2}{5}$ $\frac{4}{5} \div \frac{1}{7}$ of $2 = \frac{14}{5} = 2\frac{4}{5}$

347. $\frac{8}{9} \div \frac{4}{11} = x$
$\frac{8}{9} \div 4 = \frac{2}{9}$ $\frac{8}{9} \div \frac{1}{11}$ of $4 = 11 \times \frac{2}{9} = x$

348. $\frac{9}{10} \div \frac{2}{7} = x$
$\frac{9}{10} \div 2 = \frac{9}{20}$ $\frac{9}{10} \div \frac{1}{7}$ of $2 = 7 \times \frac{9}{20} = x$

Notice that **the method in these exercises is the same as in dividing a whole number by a fraction**; but the dividend is a fraction.

What two methods of dividing a fraction by a whole number are there?

What two methods of multiplying a fraction by a whole number?

349. $\frac{4}{5} \div \frac{3}{4} = x$ $\frac{6}{7} \div \frac{3}{8} = x$ $\frac{5}{8} \div \frac{2}{3} = x$ $\frac{5}{9} \div \frac{3}{4} = x$
350. $\frac{7}{9} \div \frac{3}{4} = x$ $\frac{9}{11} \div \frac{3}{4} = x$ $\frac{7}{8} \div \frac{2}{3} = x$ $\frac{5}{9} \div \frac{2}{3} = x$
351. $\frac{5}{8} \div \frac{3}{4} = x$ $\frac{3}{7} \div \frac{2}{3} = x$ $\frac{6}{7} \div \frac{4}{5} = x$
352. $\frac{9}{10} \div \frac{3}{5} = x$ $\frac{2}{3} \div \frac{1}{2} = x$ $\frac{11}{12} \div \frac{3}{4} = x$
353. $\frac{14}{15} \div \frac{7}{8} = x$ $\frac{8}{9} \div \frac{8}{5} = x$ $\frac{7}{9} \div \frac{3}{7} = x$
354. $\frac{8}{9} \div \frac{3}{10} = x$ $\frac{11}{20} \div \frac{2}{9} = x$ $\frac{7}{25} \div \frac{5}{9} = x$
$\frac{5}{24} \div \frac{2}{3} = x$ $\frac{3}{40} \div \frac{3}{4} = x$
355. $\frac{32}{33} \div \frac{8}{9} = x$ $\frac{11}{12} \div \frac{3}{4} = x$ $\frac{3}{4} \div \frac{15}{16} = x$
$\frac{15}{16} \div \frac{3}{4} = x$

Miscellaneous Exercises

356. May lives $\frac{3}{8}$ mi. from school, and Jennie lives $\frac{3}{16}$ mi. farther. How far from school does Jennie live?

357. $8\frac{1}{8}$ in. $- 2\frac{3}{4}$ in. $= x$ $2\frac{1}{2}$ yd. $+ 1\frac{1}{2}$ ft. $= x$ yd.

358. $\$2 = \frac{x}{100}$ of $\$5$ $\frac{10}{100}$ of $\$2 = x$¢

359. What part of a gallon is 2 qt. and 1 pt.?

360. What part of a gallon is $\frac{3}{4}$ of a quart?

361. What part of a yard is $\frac{2}{3}$ of a foot?

362. How many square feet in a rug $4\frac{1}{2}$ yd. long and 3 yd. wide?

363. $\frac{7}{8}$ of $10 = x$ $\frac{3}{4}$ of $10 = x$ $10 \times \frac{3}{4} = x$

364. How many square feet in the floor of a bathroom $9\frac{1}{3}$ ft. long and $8\frac{1}{2}$ ft. wide?

365. $8 \times \frac{3}{4} = x$ $\quad 4 \times 6\frac{2}{3} = x$ $\quad 4\frac{1}{2} \times 6\frac{1}{2}$ yd. $= x$

366. An inch on a certain map represents 20 mi. on the earth. How far apart are two cities shown $6\frac{3}{4}$ in. apart on the map?

367. How long is a county which is shown $1\frac{3}{8}$ in. long on the map?

368. $8 \times \frac{7}{16}$ in. $= x$ $\quad 5 \times \frac{3}{16}$ lb. $= x$ $\quad 4 \times \frac{11}{16}$ lb. $= x$

369. $6\frac{3}{8}$ in. $\div 3 = x$ $\quad \frac{7}{8}$ in. $\div 5 = x$ $\quad 9\frac{1}{2} \div 3 = x$

370. $2\frac{5}{6}$ h. $+ 1\frac{1}{3}$ h. $= x$ $\quad 2\frac{5}{6}$ h. $+ 8\frac{1}{4}$ h. $= x$ $\quad 5 \times \frac{17}{20} = x$

371. $2\frac{5}{6}$ h. $- 1\frac{1}{3}$ h. $= x$ $\quad \$7\frac{1}{2} \div \$2\frac{1}{2} = x$ $\quad \frac{10}{11} \div 5 = x$

372. $\frac{3}{4} \div 8 = x$ $\quad \frac{9}{10} \div 3 = x$ $\quad \frac{5}{9} \div 11 = x$

373. $\frac{7}{8} \div \frac{2}{3} = x$ $\quad \frac{8}{10} \div \frac{3}{4} = x$ $\quad \frac{5}{8} \div \frac{4}{5} = x$

374. $\frac{3}{4}$ A. $+ \frac{7}{8}$ A. $= x$ $\quad \$\frac{9}{10} + \$\frac{3}{4} = x$ $\quad \frac{7}{16}$ lb. $- \frac{3}{8}$ lb. $= x$

375. $\frac{3}{4}$ yd. $= x$ in. $\quad \frac{7}{8}$ yd. $= x$ in. $\quad \frac{5}{8}$ ft. $= x$ in.

376. $9\frac{1}{2} \div \frac{1}{3} = x$ $\quad 9\frac{1}{2} \div \frac{2}{3} = x$ $\quad 9\frac{1}{2} \div 4 = x$

377. $\frac{3}{4}$ of $\frac{2}{3} = x$ $\quad \frac{2}{3}$ of $\frac{5}{8} = x$ $\quad \frac{4}{5}$ of $\frac{3}{4} = x$

378. $6 \times \frac{5}{8} = x$ $\quad 4 \times \frac{3}{8}$ lb. $= x$ oz.

379. $\frac{1}{4}$ in. $+ \frac{9}{16}$ in. $= x$ $\quad \frac{11}{16} \div \frac{1}{4} = x$

380. $\frac{1}{8}$ of $100 = x$ $\quad \frac{3}{8}$ of $100 = x$ $\quad \frac{5}{8}$ of $100 = x$

381. $\frac{1}{6}$ of $100 = x$ $\quad \frac{5}{6}$ of $100 = x$ $\quad \frac{7}{8}$ of $100 = x$

382. $3\frac{1}{7} + 1\frac{1}{8} = x$ $\quad 2\frac{1}{2} \times 3\frac{1}{3} = x$ $\quad 3\frac{1}{2} - 2\frac{1}{3} = x$

383. $\frac{3}{5}$ yd. $= x$ inches $\quad \frac{8}{10}$ lb. $= x$ ounces

384. $\frac{17}{20} - \frac{3}{5} = x$ $\quad \frac{17}{20} + \frac{3}{5} = x$ $\quad \frac{3}{5}$ of $\frac{17}{12} = x$

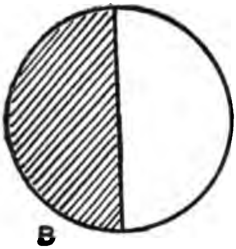
385. $12\frac{1}{2} \div 2 = x$ $\quad 1\frac{17}{20} - \frac{1}{2} = x$ $\quad 1\frac{17}{20} + \frac{1}{2} = x$

386. $3\frac{1}{2}$ in. $+ 1\frac{9}{16}$ in. $= x$ $\quad 3\frac{1}{2}$ in. $- 1\frac{9}{16}$ in. $= x$

387. $3\frac{1}{2}$ m. $\div 4 = x$ $\qquad \$8\frac{1}{2} - \$1\frac{4}{5} = x$

388. $1\frac{1}{2} \times \frac{2}{3} = x$ $\qquad 1\frac{1}{2} \div \frac{2}{3} = x$

389. A piece of cloth $\frac{3}{4}$ yd. long and $\frac{7}{8}$ yd. wide contains what part of a square yard?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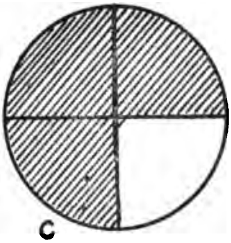
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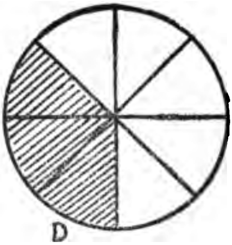
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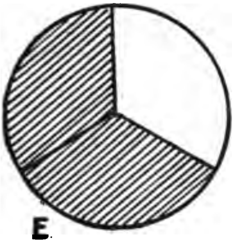
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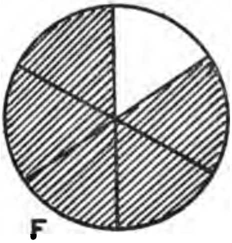
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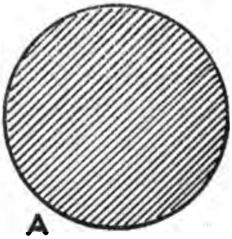
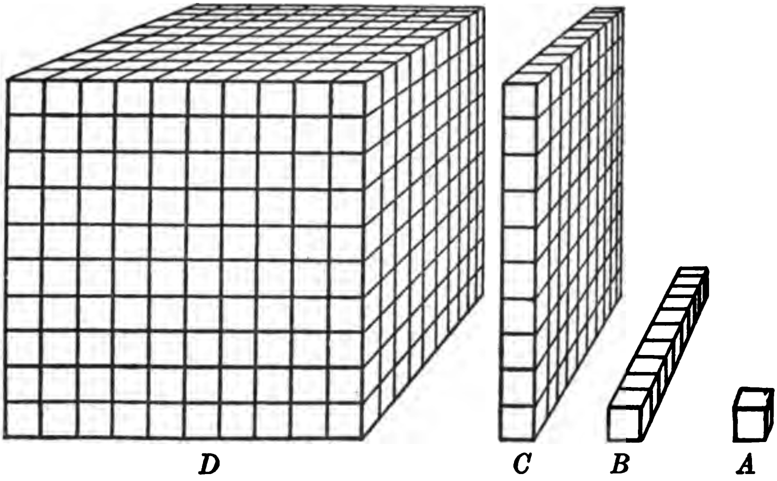

A

Think the shaded parts.

390. Taking *A* as 1, how much is *B*? *C*? *D*? *E*? *F*?
391. Taking *B* as 1, how much is *C*? *D*? *E*? *F*?
392. $\frac{3}{4} \div \frac{1}{2} = x$ $\frac{3}{8} \div \frac{1}{2} = x$ $\frac{2}{3} \div \frac{1}{2} = x$ $\frac{5}{6} \div \frac{1}{2} = x$
393. Take *C* as the measure. How much is *A*? *B*?
394. $1 \div \frac{3}{4} = x$ $\frac{1}{2} \div \frac{3}{4} = x$
395. With *C* as the measure, what is *D*? $\frac{3}{8} \div \frac{3}{4} = x$
396. How much is *E*? $\frac{2}{3} \div \frac{3}{4} = x$
397. How much is *F*? $\frac{5}{6} \div \frac{3}{4} = x$
398. Take *D* as the measure. How much is *A*? *B*?
399. $1 \div \frac{3}{8} = x$ $\frac{1}{2} \div \frac{3}{8} = x$
400. How much is *E*? $\frac{2}{3} \div \frac{3}{8} = x$
401. How much is *F*? $\frac{5}{6} \div \frac{3}{8} = x$
402. Take *E* as the measure. How much is *A*? *B*?
403. $1 \div \frac{2}{3} = x$ $\frac{1}{2} \div \frac{2}{3} = x$ $\frac{3}{8} \div \frac{2}{3} = x$



Look at the diagram in answering these questions.

1. How many of *A* equal *B?*
2. How many of *B* equal *C?*
3. How many of *C* equal *D?*
4. How many of each of these units make one of the next larger?
5. *D* equals how many *C?* C equals how many *B?* *B* equals how many *A?*
6. Each of these units equals how many of the next smaller?
7. *B* is 1 what? *C* is 1 what? *D* is 1 what?
   2*B* are what? 5*C* are what? 8*D* are what?

Write with figures:

8. *A*, 5*A*, 3*A*, 7*A*, *B*, 2*B*, 4*B*, 9*B*.
9. *BA* (*B* and *A*) as one number, *B*2*A*, 2*B*5*A*.
10. *C*, 4*C*, *CB*2*A* as one number, *C*4*B*7*A*, 3*C*2*B*6*A*.

Look at the diagram in thinking these exercises.

Write with figures:

11. *D*, 2*D*, 9*D*, 2*D*4*C*6*BA*, as one number.

Take B as the measure. **Keep the eye on it.**

12. *A* is what part? *C* is how many? *D* is how many?

Write with figures and decimal point:

13. *A*, 3*A*, 5*A*, *B*, *B*6*A*, 4*B*8*A*, 7*B*3*A*.

14. *C*, 8*C*, *C*2*B*4*A*, 5*C*9*B*3*A*, 7*C*2*B*9*A*. *D*, *D*2*C*5*B*3*A*, 5*D*9*C*3*B*7*A*.

Take C as 1. **Keep the eye on it.**

15. *B* is what part? *A* is what part? *D* is how many?

Write with figures and decimal point:

16. *B*, 2*B*, *A*, 7*A*, *BA*, *B*2*A*, 5*B*3*A*.

17. *C*, *C*5*B*, 2*C*4*B*7*A*, *D*4*C*9*B*7*A*, 9*D*4*C*3*B*7*A*.

Decimal Fractions

Take D as 1. **Keep the eye on it.**

18. What part is *C*? *B*? *A*? 2*C*? 5*B*? 8*A*?

Write with figures and decimal point:

19. *D*, 2*C*, 5*B*, 7*A*, 2*D*5*C*, 4*D*2*C*6*BA*, 7*D*4*C*6*B*3*A*.

20. Tenths are written in which place? Hundredths are written in which place? Thousandths in which place?

21. ½ tenth = x hundredths, ½ hundredth = x thousandths.

22. Half of any unit equals 5 of the next smaller.

23. A fourth of any unit equals 2½ of the next smaller.

Express wholly in decimal form:

24. 2½ tenths, 3¼ tenths, 7½ hundredths.

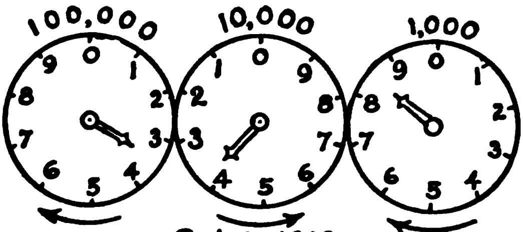
25. 27½ hundredths, 6¼ tenths.

26. 2⅗ tenths, 12½ hundredths, 2⅖ tenths.

27. 72½ hundredths, 5¼ tenths, 2¾ tenths.

Gas-Meter

28. The figures on the right dial of the gas-meter shown at the left indicate the number of hundreds of cubic feet of gas used. If the hand points to 4, it indicates the use of how many cubic feet of gas? Pointing to 7, it indicates the use of how many cubic feet? Pointing between 8 and 9, it indicates the use of how many cubic feet?



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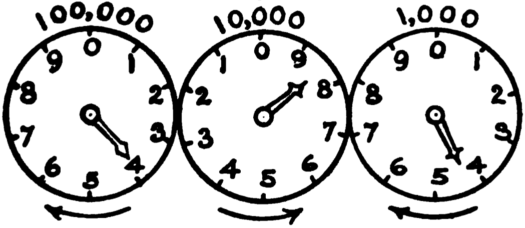

Nov 3, 1910

Gas-Meter

29. Does the hand on this dial turn toward the left or toward the right?* In which direction does the hand on the middle dial turn? The hand on the left dial?

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*The hand is said to turn in the direction in which it moves over the upper part of the dial.

30. The figures on the middle dial indicate thousands of cubic feet of gas. How far, then, does the hand on this dial move while the hand on the dial at the right makes a complete revolution?

31. When the hand on the middle dial points to 7, it indicates the use of how many thousands of feet of gas?

32. How many revolutions will the hand on the right dial complete while that on the middle dial is completing 1 revolution?

33. A complete revolution of the hand on the middle dial indicates the use of how many cubic feet of gas?

34. The figures on the left dial indicate ten-thousands of feet of gas. When the hand on this dial points to 2, it indicates the use of how many thousands of feet of gas?

35. How far does the hand on this dial move while that on the middle dial is making a complete revolution? How many revolutions will the hand on the right dial have made in the same time?

36. Review 28–35.

37. In the upper view of the meter, the hand on the left dial indicates the use of how many complete 10-thousands of feet of gas?

38. The hand on the middle dial shows that how many more complete thousands of feet have been used?

39. On the right dial it is the custom to take the reading of the nearest even figure. In this case it is what figure?

40. What is the whole number of feet of gas shown to have been used at this reading of the meter on October 4?

41. Get the reading for November 3 by answering the questions 37–40 above.

42. How many feet of gas shown to have been used November 3 have been used since the reading of October 4?

43. This is the amount charged for the month of October. At $1.00 per 1000 ft., how much is the gas bill for October?

44. If on December 2 the hand on the left dial points between 4 and 5, that on the middle dial between 2 and 3, and that on the right dial between 6 and 7, how many cubic feet of gas have been used since the November reading?

The reading of meters for water and electricity is essentially the same as for gas. The number of dials used varies with the quantities to be measured.

Division by 10, 100, 1000

46. In writing whole numbers it is common to omit the decimal point. Where would it be if written?

47. Write 2000 four times in a line, each with a decimal point. Starting at the right, remove the decimal point for the second 2000 one place toward the left, for the third 2000 two places toward the left, and for the fourth 2000 three places toward the left.

What does the second 2 now express?

48. What does the third 2 now express?

49. What does the fourth 2 now express?

50. Removing the decimal point one place toward the left really divided the number by what?

51. Removing it two places divided the number by what?

52. Removing it three places divided by what?

53. What is a short way of dividing by 10? By 100? By 1000?

54. $200 \div 10 = x$ $28 \div 10 = x$

55. $2.25 \div 100 = x$ $225 \div 1000 = x$

Write 0 in a place for which there is no other figure.

Remember that the decimal point belongs at the right when not expressed.

56. $\$400 \div 10 = x$ $\$625 \div 10 = x$

57. 760 lb. $\div 10 = x$ 200 lb. $\div 100 = x$

58. 850 ft. $\div 100 = x$ 1250 m. $\div 100 = x$

59. 2000 lb. $\div 1000 = x$ 5280 ft. $\div 100 = x$

60. 1750 lb. $\div 10 = x$ 2000 lb. $\div 100 = x$

61.* Oats bought @ $64 per 100 bu. cost how much per bushel?

62.* Butter bought @ $320 per 1000 lb. costs how much per pound?

63.* A half ton of coal (1000 lb.) cost $4.00. How much is that per pound?

64. \$280 = x 10-dollar bills   \$37,000 = x 100-dollar bills.

65. 154,000 lb. = x half tons   93,300 lb. = x half tons

66. $\frac{1}{100}$ of 5280 ft. = x $\frac{1}{10}$ of 320 rd. = x

67. At \$100 each how many shares of mill stock can be purchased for \$27,000? For \$35,000?

68. How many squares (hundred square feet) of roofing are required for 4000 sq. ft. of roof?

69. At \$500 each how many shares of bank stock can be bought for \$12,500?

Division by 5, 50, 25

70. By saving 10¢ a day, how many days would it take to save \$12.40?

71. By saving 5¢ per day, how many days would it take?

72. A earns \$5 per day. How many days will it take him to earn \$645?

First think how many days it would take at \$10 a day.

73. A house is rented @ \$50 per month. In how many months will the rent amount to \$1850?

74. How many shares of stock must be sold at \$50 to raise \$25,000?

75. How many house lots, each with 50 ft. front, can be laid out on one side of a street 1 mile (5280 ft.) long?

76. How many lots with 25 ft. front could there be?

There are 4 times as many 25's as 100's in a number.

77. How many acres of land must be sold @ \$25 each to raise \$5000?

78. How many 5-cent car fares will it take to amount to \$25.30?

79. How many 50-dollar bills equal \$12,500?

Multiplication by 10, 100, 5, 50, 500

80. Write 2 four times about $\frac{3}{4}$ in. apart in a line. Starting from the right, remove the decimal point for the second 2 one place toward the right, for the third 2 two places toward the right, and for the fourth 2 three places toward the right, writing 0 in each place where there is no other figure.

What does the second 2 now express?

81. What does the third 2 now express? The fourth 2?

82. Removing the decimal point one place toward the right multiplied by what?

83. Removing it two places toward the right multiplied by what?

84. Removing it three places multiplied by what?

85. What is a short way of multiplying by 10? By 100? By 1000?

86. What will 10 shares of railroad stock cost @ $169 per share?

87. How much will 100 shares cost?

88. Find the cost of 100 A. of land @ $19.50 per acre.

89. $10 \times \$6.25 = x$ $100 \times \$6.25 = x$

90. 10 ft. $= x$ inches, 100 yd. $= x$ feet

91. 1000 yd. $= x$ feet, 10 mi. $= x$ rods

92. 100 lb. $= x$ ounces, 1000 sq. yd. $= x$ square feet

93. 25 dimes $= x$ cents, \$200 $= x$ cents

94. Find the cost of 10 horses @ $240. Of 5 horses.

To multiply by 5, find half of 10 times the number.

95. Find the cost of 5 pairs of shoes @ $2.28.

96. Find the cost of 100 cows @ $48. Of 50 cows.

97. Find the cost of 50 bu. of corn @ 68¢. At 72¢.

Multiplication by 15, 25, 75, 9, 99, 999, 98, 198, 11, 125

98. How many square rods in a lot 24 rd. by 10 rd.?

99. In one 24 rd. by 5 rd.? In one 24 rd. by 15 rd.?

To multiply by 15, find 10 times the number and add half of that product.

100. Find the cost of 15 bbl. of flour @ $6.40. At $6.60. At $5.50.

101. Find the cost of 100 baskets of peaches @ 84¢. Of 25 baskets.

To multiply by 25, find $\frac{1}{4}$ of 100 times the number.

102. Find the cost of 25 bbl. of apples @ $2.40. At $1.60. At $1.80.

103. How many square rods in a field 25 rd. by 64 rd.? In one 25 rd. by 160 rd.? In one 25 rd. by 84 rd.?

104. Find the cost of 75 hens @ 80¢. At $1.20. At 96¢.

105. Find the cost of 1000 shares of Midway Northern Oil Co. @ 80¢. How much for 3000 shares?

106. How much less is 99 than 100?

107. How much less are 8 99's than 800?

108. Find the amount which should be received for 4 pairs of shoes @ 99¢. At 95¢.

109. For 8 shirt waists @ $1.98.

How much less is $1.98 than $2.00?

110. For 11 horses @ $175.

Eleven times $175 is how much more than 10 times $175?

Eleven times a number equals 10 times the number plus the number.

111. Find the cost of 11 yd. of carpet @ $1.40.

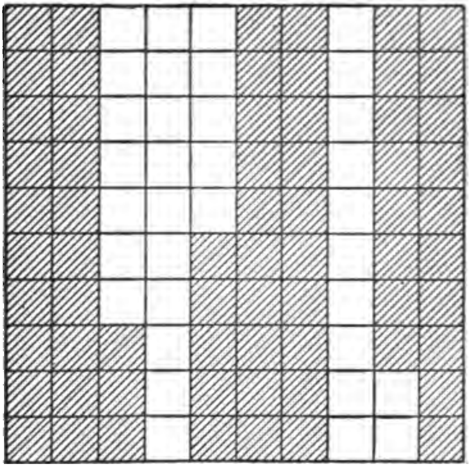
112. Of 125 mules @ $160. Of 125 A. of land @ $28.

How many hundreds equal 125? How much will 100 mules cost? How much will $\frac{1}{4}$ of 100 cost?

113. Of 250 A. @ $24.

What part of 1000 is 250?

To multiply by 250, find $\frac{1}{4}$ of 1000 times the number.



114. Into how many small equal squares is this large square divided?

Count both the shaded and white parts.

115. What part of the whole is one of these small parts? 3 parts? 27 parts?

One of these parts is also called **1 per cent.**

116. What per cent are 4 parts? 9 parts? 67 parts?

117. What per cent of the large square is the shaded part at the right?

118. What per cent is the shaded part on the left?

119. What per cent is the shaded part in the middle?

120. How many cents in a dollar? A cent is what part of a dollar? What per cent of a dollar?

121. A nickel equals how many hundredths of a dollar? What per cent of a dollar? A dime equals what per cent of a dollar?

122. 100¢ $= x$ per cent of a dollar.

123. ½ dollar $= x$ per cent of a dollar.

124. ¼ dollar $= x$ per cent of a dollar.

125. ¼ lb. $= x$ per cent of 1 lb.

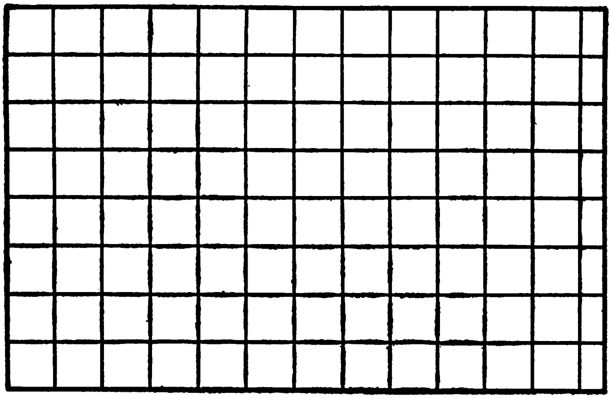
126. 4 oz. $= x$ per cent of 1 lb.

127. $\frac{1}{10}$ of 5280 ft. $= x$ 1% of 2100 lb. $= x$

128. $\frac{1}{100}$ of 5280 ft. $= x$ 3% of 2100 lb. $= x$

129. 1% of 5280 ft. $= x$ 5% of \$600 $= x$

Fractions and Equivalent Per Cents



130. How many whole squares in this diagram?

131. What part of another square in each horizontal row?

132. These parts equal how many more squares?

133. The whole squares and the parts equal how many?

134. What per cent of the whole is 1 square?

135. What per cent of the whole are 2 vertical rows?

136. What part of the whole surface is 1 horizontal row? What per cent?

137. What part are 2 rows? What per cent?

138. What part and what per cent are 4 rows?

139. 3 rows? 5 rows? 7 rows?

140. *During 2 minutes think rapidly what fraction each of the following per cents equals.* Then proceed as on page 1.

141. 50%, 25%, 75%, 20%, 80%, 40%, 60%, $12\frac{1}{2}\%$, $37\frac{1}{2}\%$, $87\frac{1}{2}\%$, $62\frac{1}{2}\%$.

142. $12\frac{1}{2}\%$ of 4800 lb. $= x$ $62\frac{1}{2}\%$ of 4000 ft. $= x$
143. 25 % of 196 lb. $= x$ 75 % of 4400 mi. $= x$
144. 20 % of \$75 $= x$ 80 % of \$75 $= x$

145. *During 2 minutes think rapidly what per cent each of the following fractions equals:*

$\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{2}{5}$, $\frac{3}{5}$, $\frac{4}{5}$, $\frac{1}{8}$, $\frac{3}{8}$, $\frac{5}{8}$, $\frac{7}{8}$.

146. Proceed as on page 1, drilling upon parts not answered correctly.

Parts of a Dollar

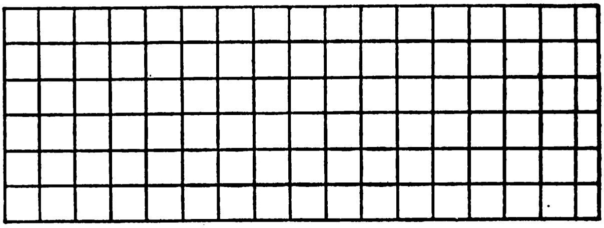
147. $\frac{1}{4}$ of $1.00 = x¢
148. $\frac{1}{8}$ of $1.00 = x¢
149. $\frac{3}{4}$ of $1.00 = x¢
150. $\frac{3}{8}$ of $1.00 = x¢
151. $\frac{5}{8}$ of $1.00 = x¢
152. $\frac{7}{8}$ of $1.00 = x¢
153. $\frac{1}{5}$ of $1.00 = x¢
154. $\frac{2}{5}$ of $1.00 = x¢
155. $\frac{4}{5}$ of $1.00 = x¢
156. $\frac{3}{5}$ of $1.00 = x¢

During 3 minutes think these exercises rapidly.

Proceed as on page 1.

Keep up the drill on this till you know it perfectly.

Fractions and Equivalent Per Cents



157. How many whole squares in this diagram?

158. What part of another square in each horizontal row?

Test with rule.

159. These parts equal how many more squares?

6 times $\frac{2}{3} = x$.

160. The whole squares and the parts together equal how many squares?

161. What per cent of the whole are 7 squares? 39 squares?

162. What per cent is 1 horizontal row?

Remember that 1 square is 1 per cent of the rectangle. Count them.

What part is 1 horizontal row?

163. What per cent are 2 horizontal rows? What part?

164. What per cent and what part are 4 horizontal rows?

Per Cents and Equivalent Fractions

165. *During 2 minutes think rapidly what fraction each of the following per cents equals:*

50%, 25%, 75%, 20%, 60%, 40%, 80%, $12\frac{1}{2}$%,
$62\frac{1}{2}$%, $37\frac{1}{2}$%, $87\frac{1}{2}$%, $16\frac{2}{3}$%, $66\frac{2}{3}$%, $33\frac{1}{3}$%, $83\frac{1}{3}$%.

166. Proceed as on page 1. Drill upon parts not answered correctly.

What Per Cent One Number is of Another

167. Five dimes equal what per cent of a dollar?

168. Five nickels equal what per cent of a dollar?

169. A half pint is what part of a quart? What per cent?

170. A pint is what per cent of a gallon?

171. A quart is what per cent of 2 gallons?

172. Three pints are what per cent of a gallon?

173. Five pints are what per cent of a gallon?

174. $3\frac{1}{4}$ in. + $\frac{6}{8}$ in. $= x\%$ of 1 ft.

What per cent is:

175. 1 pt. of 3 qt.? 3 qt. of 1 gal.? 1 qt. of 1 gal.?

176. 1 pt. of 1 gal.? 1 gal. of 1 pt.? 1 ft. of 1 yd.?

177. 1 yd. of 9 in.? 9 in. of 1 yd.? 2 ft. of 1 yd.?

178. 18 in. of 1 ft.? 2 ft. of 18 in.? 4 oz. of 1 lb.?

179. 8 oz. of 3 lb.? 2 lb. of 8 oz.? 100 lb. of 1 ton? A ton of 500 lb.?

180.* 1 yd. of 2 rd.? 6 in. of 1 yd.?

181.* 5 min. of 1 h.? 1 h. of 20 min.?

Multiplication of $33\frac{1}{3}$, $66\frac{2}{3}$, $16\frac{2}{3}$, $12\frac{1}{2}$, $37\frac{1}{2}$, *etc.*

182. Find the cost of 32 plows @ $12.50.

What part of $100 is $12.50?
The plows will cost what part of 32 × $100?

183. Find the cost of 40 acres of land at $37.50.

What part of $100 is $37.50?
The 40 acres will cost what part of 40 × $100?

184. Of 80 acres @ $87.50. Of 20 acres.

185. Of 40 acres @ $50. Of 60 acres.

186. Of 40 acres @ $62.50. Of 60 acres.

What part of $100 is $62.50?
The 40 acres will cost what part of 40 × $100?

187. Of 40 acres @ $75. Of 24 acres.

188. Of 32 acres @ $87.50. Of 48 acres.

189. Of 64 acres @ $62.50. Of 96 acres.

190. Of 24 acres @ $37.50. Of 96 acres.

191. Of 48 acres @ $102.50. Of 32 acres.

192. Of 40 cows @ $80. Of 55 cows.

193. Find the cost of 12 yd. of gingham @ $33\frac{1}{3}$¢.

What part of a dollar is $33\frac{1}{3}$c.? How many thirds of a dollar will 12 yd. cost? How many dollars?

194. Of 27 yd. of ingrain carpet @ $66\frac{2}{3}$¢.

What part of a dollar is $66\frac{2}{3}$c.?

Per Cent of Gain or Loss

195. A boat was bought for $800 and sold for $900. How much was gained? The gain was what part of the cost? What per cent?

196. A cap was bought for 75¢ and sold for 90¢. The gain was how much? What part of the cost? What per cent of the cost?

197. A drum was bought for $5 and sold for $4. Was there a gain or loss? How much? What part? What per cent?

198. A horse was bought for $500 and sold for $250. Was there a gain or loss? How much? What part of the cost? What per cent?

What per cent of the cost is gained or lost when something is bought for:

199. 60¢ and sold for 50¢? $150 and sold for $120?

200. $50 and sold for $75? $200 and sold for $275?

201. $72 and sold for $60? $200 and sold for $325?

202. $600 and sold for $700? $600 and sold for $500?

203. $600 and sold for $750? $600 and sold for $450?

204. $1500 and sold for $1200? $1200 and sold for $1500?

205. $6000 and sold for $9000? $6000 and sold for $7000?

206. $6000 and sold for $8000? $5 and sold for $7?

207. $10 and sold for $9? $10 and sold for $12?

208. $75 and sold for $80? $75 and sold for $90?

209. $150 and sold for $175? $150 and sold for $200?

210. $200 and sold for $180? $200 and sold for $175?

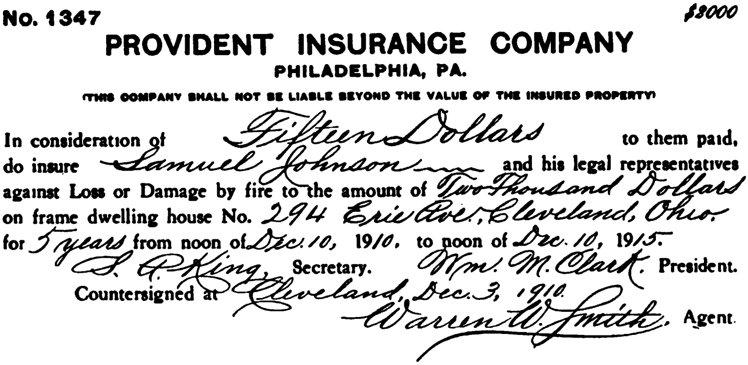
211. $200 and sold for $225? $200 and sold for $240?

212.* A gain of $38 is a gain of 95%. What is the cost? What is the selling price?

213.* By selling @ $75 there was a gain of $25. What was the cost? The per cent of gain?

Insurance

247. Fire, shipwreck, and other disasters often destroy so large a part of a person's property that the loss would be too great for him to meet if it all came upon him. Insurance companies have been formed to take the risks of such losses in return for money called **premiums,** paid to them by the owners of the property. The premium is a small percentage of the amount of the risk. The written agreement between the company and the party insured is called the **policy.** The form below shows the main features of the policy.



No. 1347 $2000

PROVIDENT INSURANCE COMPANY

PHILADELPHIA, PA.

(THIS COMPANY SHALL NOT BE LIABLE BEYOND THE VALUE OF THE INSURED PROPERTY)

In consideration of Fifteen Dollars to them paid, do insure Samuel Johnson and his legal representatives against Loss or Damage by fire to the amount of Two Thousand Dollars on frame dwelling house No. 294 Erie Ave., Cleveland, Ohio. for 5 years from noon of Dec. 10, 1910, to noon of Dec. 10, 1915.

S. A. King, Secretary. Wm. M. Clark. President.

Countersigned at Cleveland, Dec. 3, 1910.

Warren W. Smith. Agent.

248. Read the above policy. What is the name of the insurance company?

249. What does the company agree to do?

250. Who owns the property insured? What does he do to secure the insurance?

251. The money paid for insurance is called the *premium.* It is a certain per cent of the risk, *i.e.*, of the amount of the loss which the company agrees to make good.

252. A gets his house insured for 5 years against loss by fire to the amount of $1600. He pays a premium of $\frac{3}{4}\%$ of this amount for the full time; not for each year. How much is the premium?

Common periods for insurance are 1, 2, 3, 4, and 5 years.

Find the premiums for insuring:

253. A house for $2000 and furniture for $1000 for 3 yr. @ 1%.

254. A house for $3000 and a stable for $1000 @ ¾%.

Find 1%, and then ¾%.

255. A church and contents for $22,000 for 5 yr. @ ¾%.

256. A house for $2500 and furniture for $1500 @ ⅗%.

257.* A house for $5000 for 5 yr. @ ¾%.

258.* A shop for $1500 for 3 yr. @ ⅗%.

259.* B's house is insured for $2000 for 1 yr. @ ½%. Find 1% of this sum. ½%. This is the premium. What do we mean by the premium?

260. Find the premium for insuring C's house for $600 for 1 yr. @ ⅝%.

261. Find the premium for insuring D's house for $2400 for 3 years @ 1¼%.

262. Find the cost of insuring a house for $2500 @ ⅘%.

263. Suppose this building is destroyed by fire and the insurance company finds it can be rebuilt for $2000. How much is the real loss? How much is the company bound to pay?

264. Is the danger of loss by fire greater in a building with other buildings close around it, or in one with no other buildings near?

265. Is it greater in a locality with a good fire department?

266. In a wooden building, or in one built of brick, stone, or concrete, with slate, metal, or cement roof?

267. If the danger of loss by fire in a building is great, how should this affect the rate of insurance?

268. Name three things which should reduce the rate.

Interest for Entire Years and Easy Parts

People who wish to use land, buildings, carriages, etc., belonging to others, hire these things and pay for the use of them. In the same way people **needing more money than they have often hire it, and pay a certain per cent of the amount per year or month for the use of it.**

Money paid for the use of money is called *interest*. The money loaned is called the *principal*.

269. Suppose $4 is loaned for 1 year at 6%. What is 1% of $4? How much is 6%?

270. If the interest is 6% for a year, what per cent is it for 6 m.? Find the interest for 6 m.

271. What per cent is it for 2 m.? Find the interest for 2 m.

272. What per cent is it for 1 m.? Find the interest for 1 m.

273. What per cent is it for 3 m.? Find the interest for 3 m.

274. Suppose $4 is loaned @ 4% a year. Find the interest for 1 year.

275. What per cent is it for 6 m.? Find the interest for 6 m.

276. What per cent is it for 3 m.? Find the interest for 3 m.

277. Find the interest on $6 for 1 year @ 3%. Find the interest for 4 m. For 8 m. For 2 m.

What part of a year is 4 m? 8 m?

278. Find the interest on $10 for 1 year @ 5%. What per cent is it for 6 m.? Find the interest for 6 m.

279. Find the interest on $100 for a year @ 6%. For 6 m. For 2 m. For 1 m. For 3 m. For 4 m.

280. Find the interest on $20 for a year @ 4%. For 6 m. For 3 m. For 9 m.

281. Find the interest on $200 for 1 yr. @ 6%. What per cent is the interest for 6 m.? Find the interest for 6 m.

282. What per cent is it for 1 yr. and 6 m.? Find the interest for 1 yr. 6 m.

283. Find the interest on $200 for 1 yr. @ 4%. What per cent is it for 6 m.? Find the interest for 6 m.

284. What per cent is it for 3 m.? Find the interest for 3 m. For 9 m.

285. Find the interest on $40 for 1 yr. @ 3%. What per cent is it for 4 m.? Find the interest for 4 m. For 8 m.

286. Suppose $300 is loaned @ 4% a year. How much is 4% of $300? How much is the interest for 1 yr.?

287. What per cent is the interest for 6 m.? How much is it?

288. What per cent is it for 3 m.? How much is it?

289. What per cent is it for 9 m.? How much is it?

290. Suppose $600 is loaned @ 3% a year. How much is 3% of $600? How much is the interest for $\frac{1}{2}$ yr.? For 2 yr.?

291. What per cent is it for 4 m.? How much is the interest for 4 m.?

292. What per cent is it for 8 m.? How much is it for 8 m.?

293. If $400 is loaned @ 3% a year, what per cent is the interest for 4 m.? How much is it for 4 m.?

294. Find the interest of $20 for 1 yr. @ 4%. For 2 yr.

295. Find the interest of $60 for 1 yr. @ 4% a year. For 6 m.

296. Of $500 for 6 m. For 9 m.

297. Of $80 for 4 m. @ 3%. For 8 m. For 12 m.

298. Of $1600 for 6 m. @ 4%. For 9 m.

299. $1500 for 1 yr. @ 4% a year. For 1 yr. 3 m.

1% of $1500 = x 4% of $1500 = x

300. \$200 for 9 m. @ 4%. For 6 m.

4% a year = x% for 3 m. = x% for 9 m.

301. \$2000 for 1 yr. 9 m. @ 4%.

302. \$2500 for 1 yr. @ 3%.

303. \$2500 for 1 yr. 4 m. @ 3%.

3% a year = x% for 4 m. = x% for 1 yr. 4 m.

304. \$2500 for 1 yr. 8 m. @ 3%.

305. \$1600 for 2 yr. 8 m. @ 3%. \$800 for 1 yr. @ 6%.

306. \$800 for 6 m. @ 6%. For 1 yr. 6 m. @ 6%.

307. \$1800 for 1 yr. 6 m. @ 6%.

308. Find the interest of \$625 @ 6% for 6 m. For 8 m.

309.* \$1200 for 1 yr. 10 m. @ 6%. \$900 for 1 yr. 2 m.

310.* \$600 for 2 yr. 9 m. @ 4%. \$450 for 1 yr. 3 m.

Interest for any Time at Six Per Cent

Interest at 6 per cent:

311. For 12 m. (1 yr.) = $\frac{x}{100}$ of the principal

312. For 2 m. = $\frac{x}{100}$ of the principal

313. For 20 m. = $(\frac{x}{100})\ \frac{x}{10}$ of the principal

314. For 1 yr. 8 m. = $\frac{x}{10}$ of the principal

315. For 10 m. = $\frac{x}{2}$ of $\frac{1}{10}$ of the principal

316. For 5 m. = $\frac{x}{4}$ of $\frac{1}{10}$ of the principal

317. For 2 m. = $\frac{x}{100}$ of the principal

318. For 60 d. = $\frac{x}{100}$ of the principal

319. For 30 d. = $\frac{x}{2}$ of $\frac{1}{100}$ of the principal

320. For 1 m. = $\frac{x}{2}$ of $\frac{1}{100}$ of the principal

321. For 20 d. = $\frac{x}{3}$ of $\frac{1}{100}$ of the principal

322. For 40 d. = $\frac{x}{3}$ of $\frac{1}{100}$ of the principal

323. For 15 d. = $\frac{x}{4}$ of $\frac{1}{100}$ of the principal

324. For 45 d. = $\frac{x}{4}$ of $\frac{1}{100}$ of the principal

325. For 6 d. = ($\frac{x}{10}$ of $\frac{1}{100}$) $\frac{1}{1000}$ of the principal
326. For 3 d. = $\frac{x}{2}$ of $\frac{1}{1000}$ of the principal
327. For 2 d. = $\frac{x}{3}$ of $\frac{1}{1000}$ of the principal
328. For 1 d. = $\frac{x}{6}$ of $\frac{1}{1000}$ of the principal
329. For 12 d. = $\frac{x}{1000}$ of the principal

After correcting your errors made in working this exercise, *learn what part of the principal the interest at 6% is for each time indicated here.*

Find the interest at 6% on:

330. $600 for 6 d. For 18 d. For 24 d.
331. $1250 for 6 d. For 12 d. For 2 m.
332. $2500 for 10 m., for 5 m. $3000 for 1 m., for 15 d.
333. $1200 for 12 d., for 18 d. $1800 for 10 d., for 20 d.
334. $500 for 6 d. For 3 d. For 1 d.
335. $1825 for 2 m. $2000 for 1 yr.
336. $1865 for 20 m. $975 for 1 yr. 8 m.
337. $1200 for 10 m. For 5 m.
338. $800 for 5 m. $900 for 60 d.
339. $1600 for 30 d. $1500 for 20 d.
340. $900 for 40 d. $800 for 15 d.
341. $1600 for 45 d. $1200 for 6 d.
342 $1200 for 3 d. For 2 d.
343 $1200 for 1 d. For 5 d.
344. $800 for 1 yr. 8 m. For 2 m. 6 d.
345.* $1200 for 2 m. 6 d. For 20 m. 6 d. $1200 for 22 m.
346.* $900 for 1 yr. 10 m. For 1 yr. 10 m. 6 d. For 20 m. 12 d.
347.* Find the interest of $660.90 for 2 yr. 6 m. @ 4%.
348.* Of $2000 for 2 m. 6 d. @ 6%.

Find the interest at 6% on:

349. $943 for 2 m. $300 for 10 d.
350. $1400 for 1 yr. 8 m. $600 for 22 m.
351. $800 for 18 m. $600 for 18 m.
352. $320 for 10 m. $960 for 60 d.
353. $960 for 30 d. For 20 d.
354. $420 for 40 d. $300 for 20 d.
355. $300 for 1 m. 10 d. $600 for 45 d.
356. $500 for 6 d. $340 for 3 d.
357. $300 for 9 d. $600 for 1 d.
358. $300 for 7 d. $600 for 8 d.
359. $475 for 2 m. $400 for 4 m.
360. $600 for 6 m. $800 for 4 m.
361. $200 for 1 yr. 2 m. $500 for 2 yr. 8 m.
362. $675.75 for 1 yr. 8 m. $500 for 2 yr. 1 m.
363. $500 for 2 yr. 8 m. $60 for 10 m.

Find the interest on:

364. $925 for 2 yr. @ 5%. For 1 yr. 3 m. @ 4 %.
365. $750 for 3 m. @ 4%. For 6 m. @ 4%.
366. $300 for 1 m. @ 4%. For 15 d. @ 4%.
367. $500 for 4 m. @ 12%. For 6 m. @ 12%.
Interest @ 12% equals how many times the interest @ 6%?
368. $400 for 4 m. @ 3%. For 1 m. @ 3%.
369. $400 for 15 d. @ 3%. For 3 d. @ 3%.
370. $400 for 1 yr. @ 5%. For 6 m. @ 5%.
371. $400 for 3 m. @ 5%. For 1 m. @ 5%.
372. $400 for 2 m. @ 5%. For 15 d. @ 5%.
373. $150 for 3 m. @ 4%. For 1 m. @ 4%.
374.* $12 for 6 m. @ 4%. For 1 m. @ 4%.
375.* $8 for 4 m. @ 3 %. For 4 m. @ 6%.
376.* $46 for 10 m. @ 6%. For 2 d. @ 6%.
377.* $76 for 3 m. @ 8%. For 6 m. @ 12%.

Find the interest on:

378. $60 for 2 m. @ 6%. At 5%. At 4%.
379. $6 for 60 d. @ 6%. At 5%. At 3%.
380. $12 for 4 m. @ 6 %. At 3%. At 4%.
381. $72 for 20 m. @ 6%. At 4%. At 5%.

Interest @ 4% is what part of interest @ 6%?

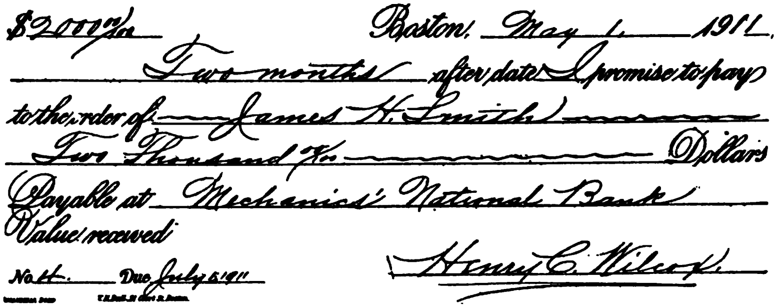
382. $300 for 6 m. @ 4%. For 3 m. For 1 m.
383. $300 for 2 m. @ 6%. For 6 d. For 1 d.
384. $300 for 3 d. @ 6%. For 2 d. For 4 d.
385. $300 for 5 d. @ 6%. For 10 d. For 20 d.
386. $300 for 9 m. @ 4%. For 15 m. For 18 m.
387. $300 for 1 d. @ 6%. At 2%. At 4%.
388. $3 for 2 m. @ 6%. At 4%. At 3%.
389. $3 for 6 d. @ 6%. For 1 d. For 2 d.
390. $400 for 20 m. @ 6%. For 1 yr. 8 m. For 10 m.
391. $400 for 5 m. @ 6%. For 60 d. For 3 d.
392. $400 for 90 d. @ 4%. For 45 d. For 30 d.

What part of a year is 90 d.?
Interest @ 4% a year is what per cent for 90 d.? For 45 d.? For 30 d.?

393. $30 for 90 d. @ 4%. For 45 d. For 30 d.
394. $30 for 60 d. @ 4%. For 15 d. For 75 d.
395. $200 for 60 d. @ 6%. For 6 d. For 2 d.
396. $200 for 62 d. @ 6%. For 66 d. For 1 d.
397. $200 for 61 d. @ 6%. For 30 d. For 31 d.
398. $200 for 1 yr. 8 m. @ 6%. For 22 m. For 18 m.
399. $200 for 10 m. @ 6%. For 8 m. For 14 m.
400. $200 for 20 m. 2 d. @ 6%. For 63 d. For 7 m.
401. $200 for 1 d. @ 6%. For 91 d. For 15 d.
402. $264 for 6 d. @ 6%. For 1 d. For 7 d.
403. $264 for 10 m. @ 6%. At 3%. At 1%.
404. $264 for 10 m. @ 4%. For 5 m. For 3 m.
405. $4200 for 2 m. @ 6%. For 3 m. For 8 m.
406. $4200 for 6 d. @ 6%. For 3 d. For 9 d.

Promissory Notes

When one person owes money to another, he often gives a written promise to pay it when demanded, or at a specified time.



$2000 00/100 Boston, May 1, 1911.

Two months after date I promise to pay to the order of James H. Smith

Two Thousand 00/100 Dollars

Payable at Mechanics' National Bank

Value received

No. 4. Due July 4/911

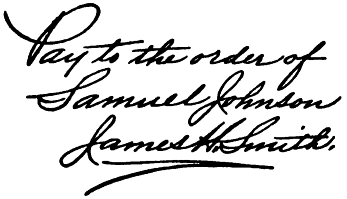
Henry C. Wilcox.

This promise is called a **promissory** note, or simply a note. Look it through carefully.

Henry C. Wilcox is called the **maker** of the note.

James H. Smith is called the **payee.**

407. On what condition would Wilcox give this promise?



Pay to the order of Samuel Johnson

James H. Smith.

Indorsement

408. Who is the maker of a note?

409. Who is the payee of a note?

Suppose James H. Smith owes Samuel Johnson $400. He may write on the back of it as indicated at the left, and pass it to Johnson in payment of his debt.

In writing his name upon the back of the note, Smith is said to **indorse** it.

The signature is called an **indorsement.**

By indorsing the note Smith **transfers his claim** to Johnson, and **binds himself to pay** the $400 to Johnson in case Wilcox fails to pay it.

Notes — Bank Discount

410. Write a note to Henry Wilson for $200, and sign it.

The person who has possession of a note and to whom it legally belongs is called the **holder of the note.**

411. Who is supposed to be the holder of the Henry C. Wilcox note?

412. Who is supposed to have been the holder before him?

413. What is meant by indorsing a note?

414. What obligation does this place upon the indorser? If Samuel Johnson wishes to get the money on this note before the two months expire, he may carry it to a national bank or a banking house and see if the bank will **cash it,** or **discount it.** This the bank will do if the officers are satisfied that the note will be paid promptly when it becomes due. If the bank is willing to cash it, Johnson indorses it by writing his name below the others upon the back, and gives it to the bank.

The bank does not pay the full amount of the note, but **deducts from it the interest at the legal rate for the time remaining before it becomes due,** and pays the balance to Johnson.

The interest deducted is called **bank discount.**

The sum actually paid for the note is called the **proceeds.**

In some states the law allows 3 days (called days of grace) more than the time specified in the note before it is legally due. In these states bank discount is reckoned to the end of the days of grace.

Pupils should follow the practice in their own state. The days of grace make these exercises more complicated, and pupils who must include these might be allowed to compute and write the discount for the time indicated by the note and for the days of grace separately, and after these parts write the total discount or proceeds required.

415. If this note is "discounted" on the day it is dated, how much is the discount?

Bank Discount

416. How much are the proceeds? When does the note become due?

417. Who should pay it? To whom?

If the maker fails to pay, the bank looks to the last indorser, from whom it received the note.

418. A note for $200 for 3 m. is discounted at a bank 1 m. after date. How much is the discount? What are the proceeds?

419. A note for $600 for 4 m. was discounted at date. How much was the discount? How much were the proceeds?

420. Find the bank discount and proceeds of a note for $80 for 2 m. discounted at date.

Borrowing from Banks

One of the most common use of notes is to borrow money from a bank.

The borrower signs a note to the bank, promising to pay the bank at the end of a specified time a sum sufficient to yield him the amount which he needs.

Each state has fixed a rate of interest as the **legal rate** for all cases in which no other rate has been agreed upon.

At the legal rate find the bank discount and proceeds of a note for:

421. $1200 for 60 d. $300 for 20 d.
422. $500 for 30 d. $600 for 45 d.
423. $600 for 3 m. $657 for 60 d.
424. $900 for 10 d. $480 for 1 m.
425. $600 for 20 d. $800 for 10 d.

Notes with Partial Payments

$2000 Chicago, June 20, 1909.

On demand I promise to pay to the order of Morse & Smith Two Thousand Dollars ($2000) with interest @ 6 per cent, value received.

Samuel L. Jones.

---

426. Feb. 20, 1910, $1000 was paid on the above note. How long was that after the note was given? What is the interest on the note to that date?

427. What do the principal and interest then amount to?

428. After the above payment, what remained unpaid?

429. The balance with the interest on it was paid Apr. 20, 1910. How long after the first payment was this? How much was the interest for this time? What was the amount due?

$1000 Philadelphia, Jan. 6, 1910.

On demand I promise to pay to the order of George Allen One Thousand Dollars ($1000) with interest @ 6 per cent, value received.

Andrew F. Slade.

---

430. March 6, 1910, $800 was paid on the above note. This was how long after the note was given? What did the $1000 and interest amount to at that date?

431. What was the balance unpaid after this payment?

432. The balance, principal and interest, due on the note May 6, 1910, was then paid. This was how long after the first payment? How much was the interest for this time? What was the amount due?

433. On a note for $500 with interest dated Jan. 7, 1913, $300 was paid Feb. 7. How long was that after the date of the note? Find the interest for this time.

434.* What payment would settle it April 7?

Notes with Partial Payments

$4000 New York, Aug. 12, 1910.

On demand I promise to pay to the order of Rufus M. Smith Four Thousand Dollars with interest at 6%, value received.

Marshall A. Sanderson.

Received on within note

$1600 Oct. 12. 1910

$1400 Feb. 12. 1911

435. Payments on the above note were made as shown by the indorsements at the left.

How much was the amount at the time of the first payment?

How much was the balance after the first payment?

436. How much was the interest from the first payment to the second? What was the balance after the second payment?

437. How much is the interest on the balance to April 12, 1911? What sum would settle the note April 12, 1911?

438. A note for $600 on demand with interest @ 6% is given Jan. 20, 1910. What does it amount to May 20?

How long is the time to May 20? How much is the interest for this time?

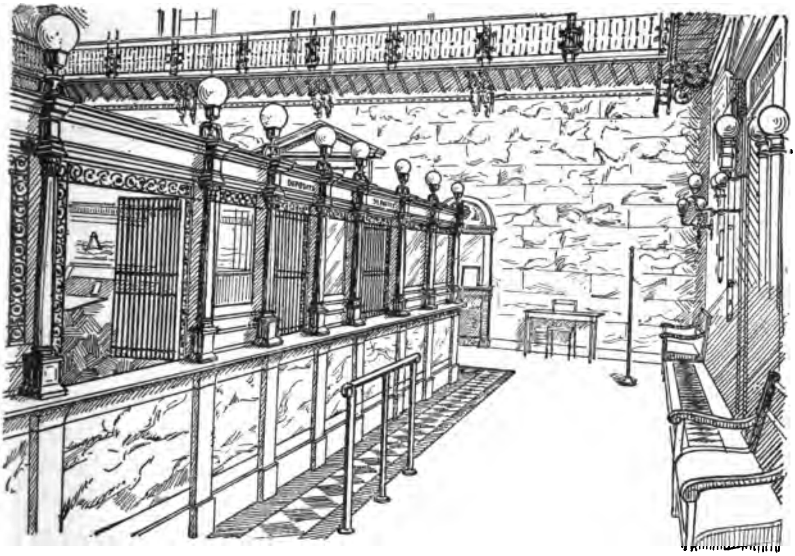
439. A payment of $400 was then made. How much was the balance unpaid? What sum would settle the note July 20, 1910?

440. On a note for $600 with interest on demand dated Jan. 1, 1911, a payment of $400 is made Sept. 1, 1911. What is the balance due after this payment?

441. On a note for $1000 with interest dated Feb. 4, 1913, $400 was paid April 4. Find the amount of the note to this time. How much was the balance unpaid after this payment?

• **442.*** Feb. 4, 1914, $300 more was paid. How much remained unpaid? What sum would settle this note April 4, 1914?

Savings Bank Interest



Savings banks differ in the times at which interest on deposits begins and the times at which interest is added to the principal.

Where necessary, the following problems should be modified to conform to the practice of the banks.

Unless otherwise stated, in all savings bank problems in this book interest on new deposits is to begin Jan. 1, Apr. 1, July 1, and Oct. 1; and interest is computed and added to the principal April 1 and Oct. 1. The rate is 4% per year. When money is withdrawn from the bank, no interest on the amount withdrawn is allowed for the time since the last dividend.

443. Mary deposits $400 Jan. 30. When will interest begin?

444. When will the first dividend (interest) be computed and added to the principal? For what time?

445. What will this dividend amount to?

446. How much has Mary then in the bank?

447. For what period is interest next reckoned?

448. How much is this dividend?

449. How much has Mary in the bank?

450. Mr. Donald deposits $1000 in this bank Sept. 30. When does interest begin? When and for what time is the first dividend computed?

451. How much is this dividend? How much has Mr. Donald then in the bank?

452. When and for what time is the next dividend made? How much is it? How much has Mr. Donald then in the bank?

453. Ned deposits $2 in the above bank Apr. 29. When does interest on this begin? When is his first dividend added? How much is it?

454.* How much has he then in the bank? How much is the next dividend? How much has he then in the bank?

455. March 10 A deposits $800 in a savings bank. When does interest begin? When is the first dividend computed? How much is the dividend?

456. What is the new principal? When is the next dividend computed?

457. How much is it? What is the new principal? When is the next dividend computed. How much is it?

458. April 5 Frank deposited $20 in a savings bank. When does interest begin? When is the first dividend computed? How much is it?

459. What is the new principal? When is the next dividend computed?

460. How much is it? What is the new principal?

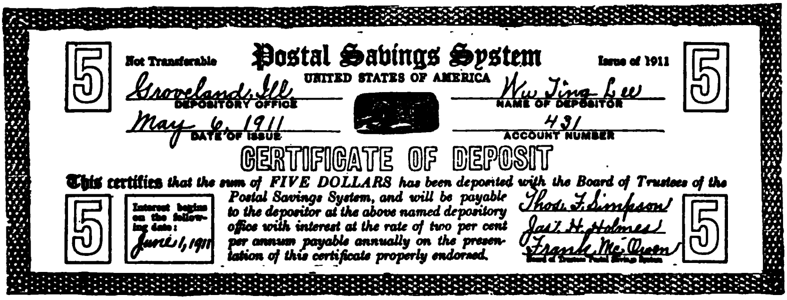
461 When is the next dividend computed? How much is it? What is the new principal?

462 September 10 Helen deposited $10 in a savings bank. When does interest begin? When is the first dividend computed? How much is the first dividend? What is the new principal?

Postal Savings System

A Postal Savings Depository was opened Jan. 3, 1911, at one post office in each state in the Union, to ascertain if there is a demand for such depositories. These were used, and many others have been established.

The expense of these depositories is borne by the government and deposits are not taxable. Any person ten years of age or older who uses the post office in which a depository is established may deposit any entire number of dollars from 1 to 500 and receive certificates for the amount. Deposits, in amounts from \$20 to \$500, may be exchanged for 2½% Postal Savings Bonds. The government furnishes the banks blank deposit certificates for \$1, \$2, \$5, \$10, \$20, and \$50.



5 Not Transferable **Postal Savings System** Issue of 1911 5

UNITED STATES OF AMERICA

Groveland, Ill.
DEPOSITORY OFFICE

Wu Ting Lee
NAME OF DEPOSITOR

May 6, 1911
DATE OF ISSUE

431
ACCOUNT NUMBER

CERTIFICATE OF DEPOSIT

This certifies *that the sum of FIVE DOLLARS has been deposited with the Board of Trustees of the Postal Savings System, and will be payable to the depositor at the above named depository office with interest at the rate of two per cent per annum payable annually on the presentation of this certificate properly endorsed.*

Interest begins on the following date: June 1, 1911

Thos. F. Simpson
Jas. T. H. Holmes
Frank McQueen
Board of Trustees Postal Savings System

5 5

463. Read this certificate carefully, and compare it with a silver certificate in regard to who issues it, to whom payable, and interest.

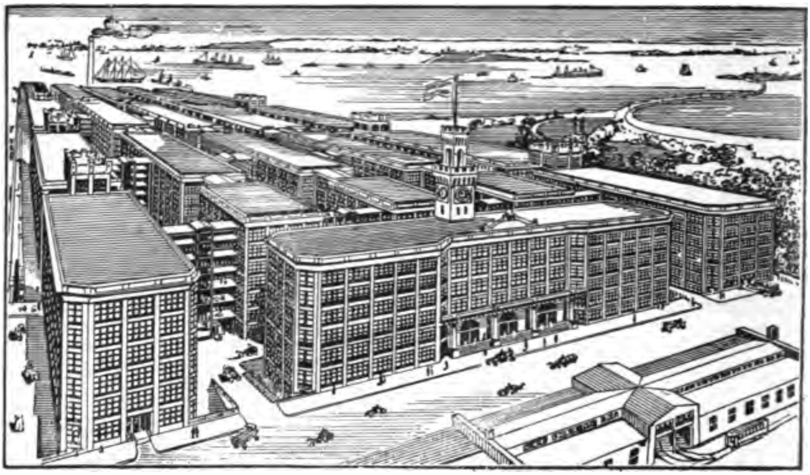
464. Is this rate of interest higher or lower than is paid by savings banks organized under state laws in your vicinity? Why should any choose to use the postal savings depositories?

465. Find the interest on this deposit of \$5 to Feb. 1, 1912.

466. A deposits \$13 in a postal savings bank Feb. 1. How many certificates must be issued to him? What is the amount of each?

467. When does interest on this deposit begin? Find the interest for 1 yr. Accrued interest bears no interest.

Stocks



Factory Colony

Few single individuals have the amount of capital necessary to build, equip, and operate a railroad, a steamship line, or a large factory. **For such enterprises it is usual for a number of persons to unite their capital.**

In accordance with the laws of some states **a corporation is formed, an organization authorized to do business as an individual.**

The capital, also called **stock, is divided into a certain number of equal parts, or shares.**

The shares are purchased by people who wish to invest in the business, **each purchaser receiving a certificate** that he is the owner of the number of shares which he has purchased.

These shares are bought and sold in the market on commission.

468. A corporation, with a capital of $120,000 in 1200 shares, is formed for the purpose of building and operating a cotton mill in Alabama. What is the face, or par, value of 1 share?

Shares sell in the market for more or less than the par value, according as the business is successful or unsuccessful, and as money seeking investment is plenty or scarce.

When business is prosperous, will stock sell higher, or lower? If money is scarce, how will prices be affected?

The business of a corporation is managed through a board of directors chosen by the shareholders.

469. A portion of the earnings of the mill is divided among the stockholders. For a time it is able to make dividends of 4% of the par value of the capital stock semi-annually. What income does an owner of 20 shares receive in a year?

470. If he paid the par value for his stock, what per cent does he realize on his investment?

471. What is the cost of 10 shares of this @ \$133⅓?

472. How much above par is this?

473. If the dividends continue the same, what per cent does this buyer realize upon his investment?

Eight dollars on \$133⅓ is how many dollars on \$100?

474. Suppose 10 shares were purchased through a broker at a commission of ¼% of the par value. How much is the commission per share? How much for the 10 shares?

475. What will 10 shares of American Telephone and Telegraph Co. cost at \$142¼ if purchased through a broker whose commission is ¼% of par value?

476. What will 100 Atch. T. & S. F. R.R. Co. cost at \$121 and commission of ¼% (of par value, \$100)?

477. Find the cost of 50 shares of Pacific Oil Co. @ \$3.50.

478. Find the cost of 100 Manhattan El. @ 134½.

479. Find the cost of 10 shares of N. Y., N. H. & H. @ 170½.

480.* An 8-per cent stock purchased at \$160 per share, will pay what per cent upon the investment?

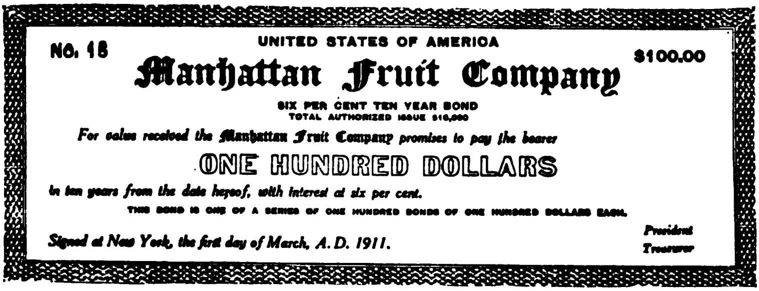
It pays \$8 on \$160. How much is it on \$100?

481.* An agent's commission for selling goods at 5% was \$350. What were the proceeds?

5% = \$350 100% = x 95% (proceeds) = x.

482. Under what condition is the market price of a stock likely to rise?

Bonds



NO. 18

UNITED STATES OF AMERICA

Manhattan Fruit Company

$100.00

SIX PER CENT TEN YEAR BOND

TOTAL AUTHORIZED ISSUE $10,000

For value received the Manhattan Fruit Company promises to pay the bearer

ONE HUNDRED DOLLARS

in ten years from the date hereof, with interest at six per cent.

THIS BOND IS ONE OF A SERIES OF ONE HUNDRED BONDS OF ONE HUNDRED DOLLARS EACH.

Signed at New York, the first day of March, A.D. 1911.

President

Treasurer

Illustrative Bond

483. How much would the above bond cost @ 125% of its face value, without commission? How much is the commission for selling this bond @ ¼%?

Commission upon stocks and bonds is always reckoned upon the face value.

484. Find the cost of $1000 of American Tel. & Tel. 4's (4 per cent) at 104 (%) and commission of ¼%.

485. How much is the annual income from this bond?

486. Find the value of $1000 of Wisconsin Central 4's @ 94½.

487. Find the value of $15,000 of Northern Pacific 4's @ 102.

488. How much is the annual income from these bonds?

489. United States government bonds are not taxable. Others generally are. If the owner of the bonds in 487 above, paid a tax of $15 per thousand on their face value, how much per $1000 would his net income from them be?

490. The tax is what per cent of the face of the bonds?

491. The net income is what per cent of the face of the bonds?

492. Find the cost of $1000 Balt. & O. Gold 4's @ 90⅜ without commission. How much is the annual net income from these bonds, if taxed as above?

1. A town with taxable property valued at $2,000,000, raises $20,000 by taxation. How many thousand dollars of taxable property in the town?

2. What part of the whole tax must be raised on 1 thousand dollars of the property?

3. How much must be raised on 1 thousand dollars of property?

Make the division easy by leaving off the same number of zeros in both divisor and dividend.

4. How much must be raised on 2 thousand dollars of property? How much on $2500?

5. How much on $4500?

Land and buildings are real estate. Other property is personal property.

6. A man's house and land in this town is valued at $3500, and his taxable personal property at $1500. How much is the tax on his property?

7. Another person's taxable property in the town was valued at $1250. How much is his tax?

8. Another town has taxable property valued at $3,000,000 on which to raise a tax of $45,000. How many thousand dollars of taxable property in the town? What part of the whole tax must be raised on $1000 of property?

9. How much must be raised on each thousand?

To find how much must be raised on each thousand dollars of property, divide the whole tax by the number of thousand dollars of taxable property in the town.

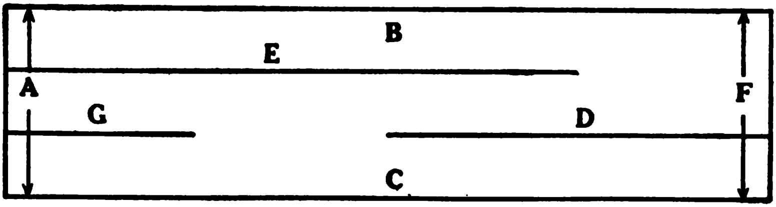
10. How much is the tax on $2500 in this town?

11. Find the tax rate per $1000 in a town having a tax of $48,000 to raise on a valuation of $4,000,000.

12. How much is the tax in this town on real estate valued at $2000 and personal property valued at $1500?

13. Find the amount of A's tax in this town, including the tax on property valued at $2100 and a poll-tax of $2.

Comparison



1. What two other lines are just as long as *A?*
2. What line is twice as long as *A?*
3. *A* equals what part of *D?*
4. *D* and *G* together equal what line?
5. *G* equals what part of *E?*
6. *D* equals what part of *E?*
7. *C* equals how many times *D?*
8. *D* equals what part of *B?*
9. *B* equals how many times *F?*
10. *F* equals what part of *B?*
11. *E* equals what part of *B?*

Measures

12 inches (in.) = 1 foot (ft.)
3 feet = 1 yard (yd.)
16½ feet, or 5½ yards = 1 rod (rd.)
320 rods or 5280 feet = 1 mile (mi.)

A hand is 4 inches, and is used in measuring the height of horses and cattle.

A fathom is 6 feet, and is used in measuring the depth of the sea.

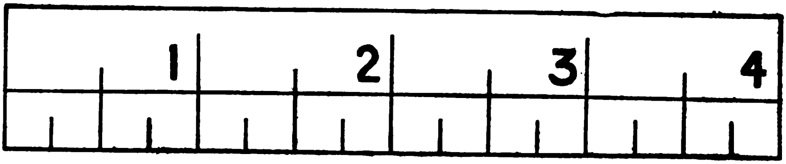
A pace is generally considered 3 feet, and is used in measuring distances by steps.

A chain is 4 rods, or 66 feet, and is used in measuring land.

A knot is a nautical, or geographical mile, and equals 1.15 common miles. It is used for measuring distances upon the sea.

A league is 3 miles. Upon the sea it is 3 nautical miles; upon the land, 3 common miles.

Inches



12. How many inches long is the rule above?

13. How many half inches in 1 inch? In 2 inches?

14. Each half inch is divided into how many equal parts? What are these parts?

15. How many quarters in 1 in.? In 2 in.? In 3 in.?

16. Place the edge of a slip of paper against the edge of the rule, with the corner even with the end of the rule. Make a dot on the paper 2 in. from the end of the rule, and mark the dot 2.

17. Place another dot $1\frac{1}{2}$ in. from the end, and mark it $1\frac{1}{2}$.

18. Another dot $3\frac{1}{4}$ in. from the end, and mark it $3\frac{1}{4}$.

19. Another dot $\frac{3}{4}$ in. from the end.

20. Make a dot about $\frac{1}{2}$ in. from the left edge of a sheet of paper. Look at the rule and notice how long an inch is. Without measuring, place another dot at a point which you think is just an inch to the right of the first dot. Measure. If not right, make a heavier dot just 1 in. from the first.

21. Notice how long 2 in. on the rule is. Try to place dots 2 in. apart. Measure. Correct if not right.

22. Notice 4 in. on the rule. Place dots 4 in. apart. Measure. Correct.

23. Notice 3 in. Place dots 3 in. apart. Measure. Correct.

24. Notice 8 in. (twice 4 in.). Place dots. Measure. Correct.

25. Think 6 in. (4 in. and 2 in.). Place dots. Measure. Correct.

Repeat this exercise occasionally.

Estimating Lengths

To the Teacher: It would be well to have marked upon a front blackboard parallel lines 1 ft., 4 ft., 6 ft., 8 ft. and 10 ft. long.

Estimate and write estimates of the following lengths:

26. The width of your desk.

27. The length of the teacher's desk.

28. The width of the doors. The height of the doors.

29. The width of the windows. Their height.

30. The width of the front blackboard. Its height.

31. The height of the chalk racks above the floor.

32. The height of the window seats above the floor.

33. The height of your desk.

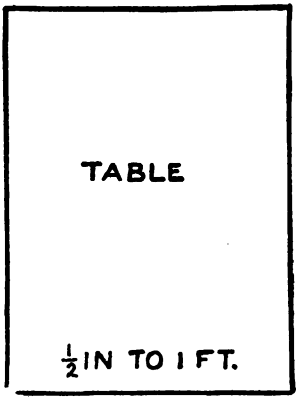
34. The width of this page. Its length.

35. Width of the schoolroom. Its length. Its height.

36. The length of the building. Its width.

Have these lengths measured and corrections made.

Drawing to Scale



To the Teacher: It is well to take development exercises orally.

37. Could a table be drawn 3 ft. wide and 4 ft. long upon this page?

38. A smaller drawing which will show the shape of the table is given at the left. How many half inches wide is the drawing? How wide is the table?

39. The drawing measures how much for each foot which the table measures?

40. How long is the drawing? How many half inches long is it? How long is the table?

41. The drawing measures how much for each foot which the table measures?

42. The table is drawn to **scale, ½ in. to 1 ft.** One half inch in the drawing means how much in the table?

43. Draw to scale, ½ in. to 1 ft., a line 8 ft. long.

44. How many half inches long is the drawing?

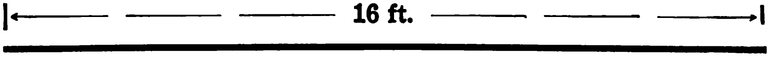
45. How many inches long?

46. A rug is 4 ft. wide and 6 ft. long. Draw it to scale, ½ in. to 1 ft.

47. How many half inches long is it?

48. How many inches long?

49. How many half inches wide? How many inches?



50. This line represents one side of a floor. How long do you think the line is?

51. Measure it, and write its exact length.

52. An inch of the line represents what length of the floor?

53. What part of an inch in the line represents 1 ft. on the floor?

54. The side of the floor is said to be drawn upon a scale of ¼ in. to 1 ft. This means ¼ in. of what?

55. It means 1 ft. of what?

56. Draw by rule upon paper a side of a lot 10 rd. long upon a scale of ¼ in. to 1 rd.

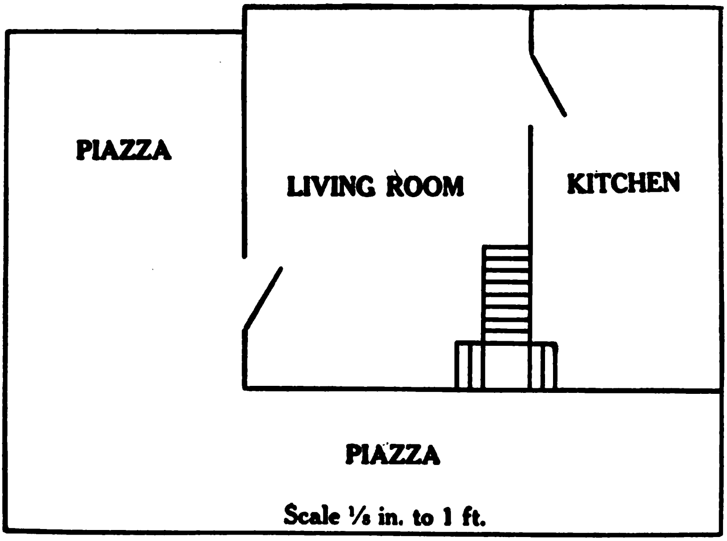
57. How many quarter inches long do you draw it?

58. How many inches long?

59. Draw the same on a scale of ⅛ in. to 1 rd.

60. How many eighth inches long must it be?

61. How many inches long?



62. Notice the scale of this plan as marked on the piazza and find out by measuring how wide the front piazza is.

63. How wide is the side piazza?

64. How wide is the house without the piazza?

65. How long is the house without the piazza?

66. How long is the living room?

67. How wide is it?

68. How long is the kitchen?

69. How wide is it?

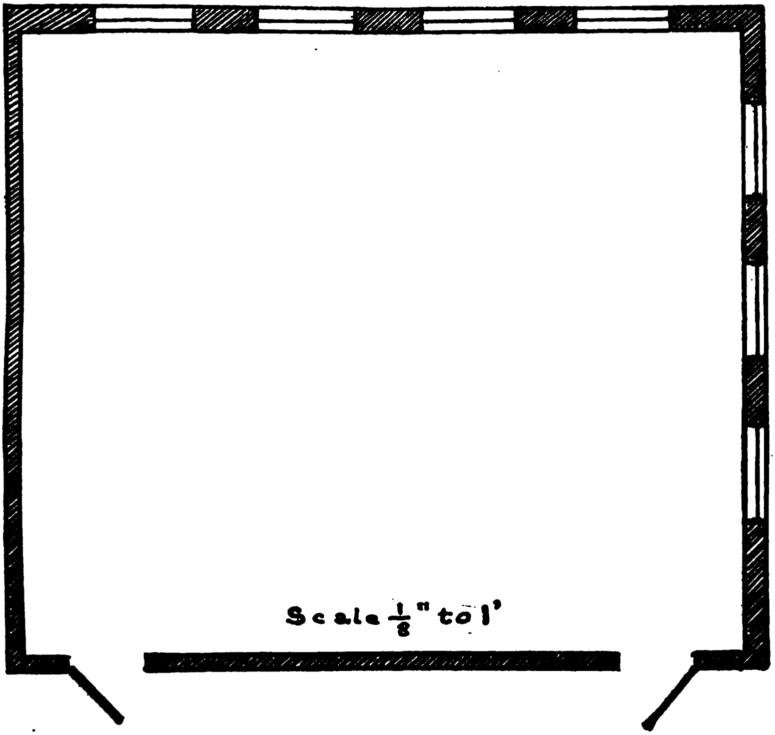
70. How wide is the front door?

71. Upon a scale of $\frac{1}{4}$ in. to 1 ft. draw a line 10 ft. long.

How many quarter inches long must it be?

72.* Draw a line 28 ft. long on a scale of $\frac{1}{8}$ in. to 1 ft. How many inches long must the drawing be?

73.* Draw the plan shown above to scale $\frac{1}{4}$ in. to 1 ft.



74. Notice the scale of this plan, estimate the width of the windows, and write the estimate.

75. Measure, and find the width accurately.

76. Estimate the width of the room from front to back, and write the estimate.

77. Find the width by measuring.

78. Estimate the length of the room from left to right, and write the estimate. Find the length by measuring.

79. Estimate the distance between the windows, and write. Measure and find the distance.

80. Mary's pansy bed is 4 ft. wide and 6 ft. long. A plan of it on a scale of $\frac{1}{2}$ in. to 1 ft. should be how many half inches long? How many inches long? How many half inches wide? How many inches wide?

81. Draw the perimeter of the plan, ruling and measuring.

82. The rows of pansies are 1 ft. apart, and run the longer way of the bed. How far apart should they be drawn on the plan?

83. The outside rows are 6 in. from the sides of the bed. How far from the sides should they measure on the plan?

84. Mark the rows on the plan by ruled dotted lines.

85. The plants are 6 in. apart in the rows and 6 in. from the ends of the bed. How far apart should they measure on the plan? How far from the ends? Represent the plants in the rows by crosses, measuring with the rule.

86. How many plants in a row?

87. How many in the bed?

88. If the plants at the ends of the rows had been set only 3 in. from the edge of the bed, and 6 in. apart, how many more would there have been in each row? How many in all?

Rods

89. Starting from a front corner of the schoolroom, one pupil measure $5\frac{1}{2}$ yd. along the front side of the room, and mark the end of it on the wall. Others see that he does it correctly.

90. This length is a rod. How many feet does it equal?

91. 2 rd. = x feet   3 rd. = x feet

92. 4 rd. = x feet   6 rd. = x feet

93. If 7 steps equal 1 rd., 28 steps equal x rods.

94. Each pupil get a strong string about 18 ft. long which will not stretch much, and tie a knot near each end, leaving just a rod between the knots.

95. With the string as a measure, and with some one to help, mark off a distance of 6 rd. on your grounds at home or in the street in front of your house.

96. Walk over this distance several times with your usual step, counting the number of steps each time. In this way find how many steps you usually take to the rod.

97. If you walk to school, count the steps which you take in going, and find how many rods you live from the school.

98. By measuring or inquiry the class should fix upon two points a mile apart known to all. Each pupil should walk over this distance, and notice how long it takes, and how long the distance seems.

Suggestions for Measuring a Mile

The measuring indicated below may be done outside of school hours and distributed through several days.

1. Select a piece of street or road a mile or more in length and well known to the class. Get a piece of strong string 5 rd. 2 ft. long, and tie a knot 1 ft. from one end and another knot 5 rd. from the first. How far should the second knot be from the other end?

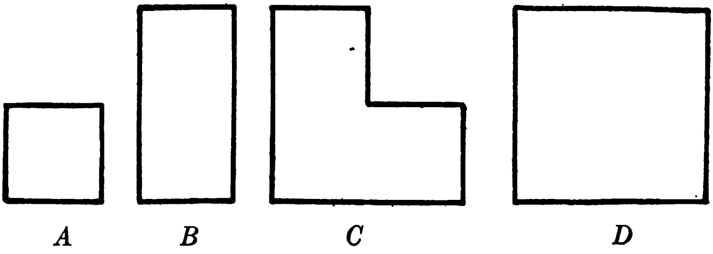
2. Let two pupils, beginning at the nearer end of the distance selected, measure 40 rd. in the direction agreed upon, and mark the end of the 40 rd. What part of a mile is this? Let two other pupils measure 40 rd. from the same point in the same direction. If they do not agree with the first two let others try.

3. Let each member of the class walk with even steps over this distance, counting his steps. Then let each measure off an equal distance beyond this by walking over it and counting his steps.

4. Let four pupils, working in pairs independently, measure the second 40 rd. with the string, and mark the end.

5. Continue in this way, the pupils pacing off 40 rd. at a time, and two or four of them testing the distance by measuring, and making corrections, until the mile has been measured.

Comparison

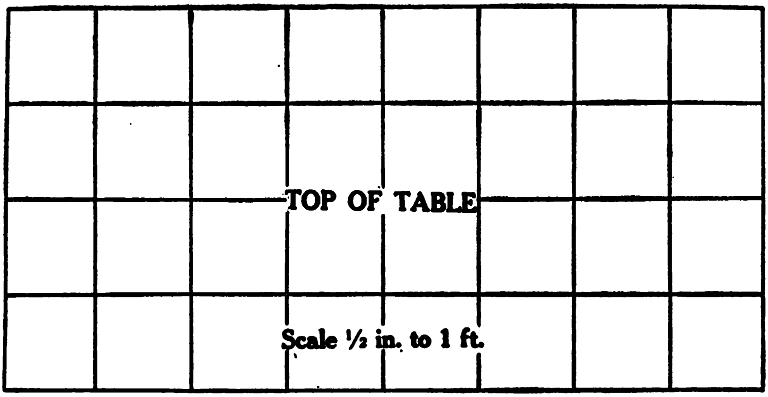


1. Take A as 1. How much is B? C? D?
2. $B + C = x$ $C + D = x$
3. $A + B = x$ $B + D = x$
4. Take B as 1. How much is D?
5. How much is A? C?
6. $C + A = x$ $C - A = x$
7. $C \div A = x$
8.* Take C as 1. How much is A? B?
9.* How much is D?
10.* $D \div A = x$ $D \div B = x$
11.* $D + C = x$ $C \div B = x$

Measures

144 square inches (sq. in.)	= **1 square foot** (sq. ft.)
9 square feet	= **1 square yard** (sq. yd.)
30¼ square yards **272¼ square feet**	= **1 square rod** (sq. rd.)
160 square rods	= **1 acre** (A.)
640 acres	= **1 square mile** (sq. mi.), **or section**
36 square miles	= **1 township** (tp.)
100 square feet	= **1 square** (in roofs, floors, etc.)

Area of Rectangle



12. How large do the squares shown in the diagram of the top of the table measure?

13. How large a square does each represent?

14. How long is the table? How many square feet in one row from left to right?

15. How wide is the table? How many rows of square feet?

To find the amount of surface in a rectangle, find:
How many square units in 1 row.
How many rows.
How many squares in all the rows.
The amount of surface is called the ***area.***

16. How large a square would you use for measuring the amount of printed surface in one of these pages?

17. Measure and find how many square inches in 1 row across the page, how many of these rows, and how many squares in all the rows.

18. What square would you use in finding the area of a floor?

19. How many square feet of ground are used for 1 row of Mary's pansies (page 102)?

20. How many square feet in the whole bed?

21. Find the number of square feet in 1 row on the floor along the nearer side of the room shown on page 101.

22. In 10 rows. In 20 rows.

23. In the whole floor.

24. In the floor of the kitchen on page 100.

25. In the landing on the stairs.

26. In the floor of the living room including the part under the stairs.

27. In the front piazza.

28. Give in yards the length and width of the living room mentioned above.

29. How many square yards in the floor?

30. Find the cost of dressing and polishing this floor @ 25¢ a square yard.

31. Find approximately the number of square feet in the floor of your school room, making no account of fractions of feet in the dimensions if there are any.

Carpeting

32. A room is 15 ft. wide and 18 ft. long. Give its width in yards. Its length.

33. How many square yards in the floor?

34. Strips of ingrain carpeting and straw matting are a yard wide. How many strips of matting running the longer way of the room are required to cover this floor?

35. If each strip is cut 6 in. longer than the room for folding the ends under, how many yards of matting are required for each strip?

36. How many for all the strips?

37. How much would this cost @ 50¢ a yard?

38. Give in yards the dimensions of a floor 12 ft. by 18 ft.

39. Allowing 3 in. at each end for folding under, how many yards of ingrain carpeting are required for 1 strip running the longer way of the floor mentioned above?

40. How many strips are required?

41. How many yards in all the strips?

42. How much would it cost @ 75¢ per yard?

43. Some carpeting is made 27 in. wide. This is how many feet wide?

44. How wide a floor would 2 strips of this width cover? 3 strips?

45. 4 strips? 6 strips?

46. How many such strips are required for a floor 8 ft. wide?

If part of a strip is required, a whole strip must be purchased. Count part of a strip as a whole strip?

47. How many for a floor 10 ft. wide?

48. For a floor 14 ft. wide?

49. For a floor 16 ft. wide?

50. For a floor 18 ft. wide?

51. A floor is 15 ft. by 20 ft. How many strips of ingrain carpeting running the longer way of the floor are required?

52. How many yards in 1 strip cut 6 in. longer than the room for folding under?

53. How many in all the strips?

54. How much will it cost @ $1.25?

Consider this room 18 *ft. wide and repeat* 51-54.

55. How many strips of carpeting 27 in. wide are required in a room 15 ft. wide?

56. The strips are 19 ft. long. How many yards in each? How many in all.

Find the cost @ $1.50 a yard.

Wall Papering

The more common wall papers are sold in rolls, each containing a strip 18 in. wide and 24 ft. long, and in double rolls containing strips twice as long.

Some wall papers of the better grades are made more than 18 in. wide; but in that case the rolls are shorter. A roll always contains 4 square yards of paper.

In exercises in this book consider strips of wall paper 18 in. wide unless some other width is specified.

57. How many strips of wall paper are required for a space 6 ft. wide? For one 7 ft. wide? 8 ft. wide?

58. How many for a wall 10 ft. wide? 12 ft. wide?

59. For a wall 14 ft. wide? 18 ft. wide? 28 ft. wide?

60. How much width of wall paper would be required for a room 12 ft. by 16 ft. if there were no windows or doors? How many strips?

In estimating the quantity of paper required for a room in the following exercises, deduct from the whole width around the room (the perimeter) half the width of the doors and windows. Consider these each 4 ft. wide.

To estimate closely, one must examine the pattern of the paper carefully, to see how great the waste will be, and notice the heights of the windows and doors as compared with the height of the room.

61. If there are 3 doors and 4 windows in the above room each 4 ft. wide (including frame and casing), how much should be deducted from the total width of paper required? How much remains?

62. How many strips of paper are required?

63. If the above room is 8 ft. high, the baseboard 9 in. high, and the design on the paper such that there is a waste of not more than 6 in. on each strip in matching figures, how many strips will a roll make? How many rolls are required?

64. A room is 14 ft. by 16 ft., with 4 doors and 4 windows averaging 4 ft. wide. How great is the perimeter of the room? How much should be deducted from this for doors and windows? How much width of paper must be furnished? How many strips are required?

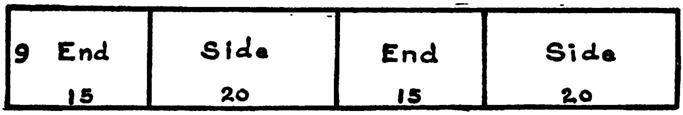
65. If the strips must be 7 ft. long, how many will a roll make? How many rolls will be required?

In making the estimate for wall paper, find:

The total width required.
The number of strips.
The length of strips.
The number of strips in a roll or double roll.
The number of rolls.

Plastering

66. In thinking the area of the walls of a room, it is convenient to think the four walls as one long rectangle whose length equals the perimeter of the room and whose width is the height of the room. What is the total length of the walls shown in the following diagram? How many square yards in them?



67. How much would it cost to lath and plaster the walls of this room @ 40¢ per square yard?

68. How long and wide is the rectangle which equals the walls of a room 12 ft. by 18 ft., and 9 ft. high?

69. How many square yards in it?

70. How much would the labor of lathing these walls cost @ 4¢ per square yard?

71. How much would the labor of plastering these walls cost @ 6¢ per square yard?

72. What are the dimensions of a rectangle which equals the walls of a room 15 ft. by 18 ft., and 9 ft. high? How many square yards in the walls and ceiling?

73. Find the cost @ 8¢ per square yard of mortar for plastering this room.

74. Laths are commonly sold in bundles of 100 each, and 100 will cover 6 sq. yd. How many bundles are required for the above room?

75. How much will they cost @ 30¢ per bundle?

76.* Find the number of square yards in the walls and ceiling of a room 15 ft. by 21 ft. by 9 ft. The cost of laths for the room @ 30¢ per 100. Of the labor of lathing @ 4¢ per square yard. Of the mortar @ 8¢ per square yard. Of the labor of plastering @ 7¢. The total cost.

77. How many square yards in the walls of a room 18 ft. square and 9 ft. high.

78. How many square yards in the ceiling of this room? How many square yards in both walls and ceiling?

79. How much will it cost to tint the walls and ceiling of this room with Jap-a-lac @ 8¢ per square yard?

80. Find the cost of calcimining the walls of the room in 79 @ 5½¢ a square yard.

81. A kitchen is 12 ft. by 13½ ft., and the walls are sheathed with yellow pine to a height of 3 ft. from the floor. How many square yards of sheathing are there? How many square yards in the floor?

82. How much will it cost to give this sheathing and floor two coats of shellac @ 15¢ per square yard?

83. This kitchen is 9 ft. high. How many square yards in the part of the walls above the sheathing?

84. How many square yards in the ceiling? How many in the ceiling and the walls above the sheathing?

85. How much would it cost to lath and plaster this surface @ 33⅓¢ per square yard?

86. How much would it cost to paint this plastering two coats @ 15¢ per square yard?

87. How many square yards in the ceiling and walls of a room 16½ ft. by 18 ft. by 9 ft.?

Square Rods

88. Starting from a front corner of the schoolroom, measure and mark off upon the floor a square whose sides are a rod long.

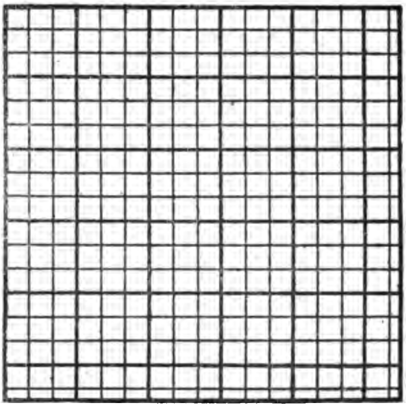
89. What shall we call this square?

90. By measuring find out what the square on this page represents, what the large squares within it represent, and what the smaller ones represent.

91. How many square yards in a whole row across the square rod? How many of these rows?

92. How many square yards in the 5 rows? How many in the half row?

93. How many square yards in the square rod?



Scale ⅛ in. to 1 ft.

94. How many square rods in a lot 10 rd. by 4½ rd.?

95. In a lot 8 rd. by 6¾ rd.?

96. In one 40 rd. by 1½ rd.?

97. In one 12 rd. by ½ rd.?

98. In one 12 rd. by 3½ rd.?

99. In one 16 rd. by 6¾ rd.?

Acres

100. If there is room in the school grounds, measure off a piece 16 rd. long and 10 rd. wide, and drive a stake in each corner. Let it include the school buildings if necessary. If possible, lay this out so that it will have the same boundaries as the school grounds on two sides.

101. If the school grounds are too small to contain this area, look for a vacant lot near the school. If that is not to be found, begin at the corner of two streets at right angles, and measure off on one street 16 rd. and on the other 10 rd., and mark the ends of these distances.

102. Think of two other lines, one starting from each of these points at right angles to the lines just measured, and extending into the block until they meet.

103. How long are these lines?

104. What is the shape of the land inclosed by these four lines?

105. How long is it? How wide is it?

106. How many square rods in a row the longer way? How many of these rows in the piece?

107. How many square rods in the whole?

160 sq. rd. = 1 acre.

How many acres in a field:

108. 160 rd. by 2 rd.? 160 rd. by 8 rd.?

109. 80 rd. by 2 rd.? 40 rd. by 2 rd.?

Parts of Square Mile

110. How many rods in a mile?

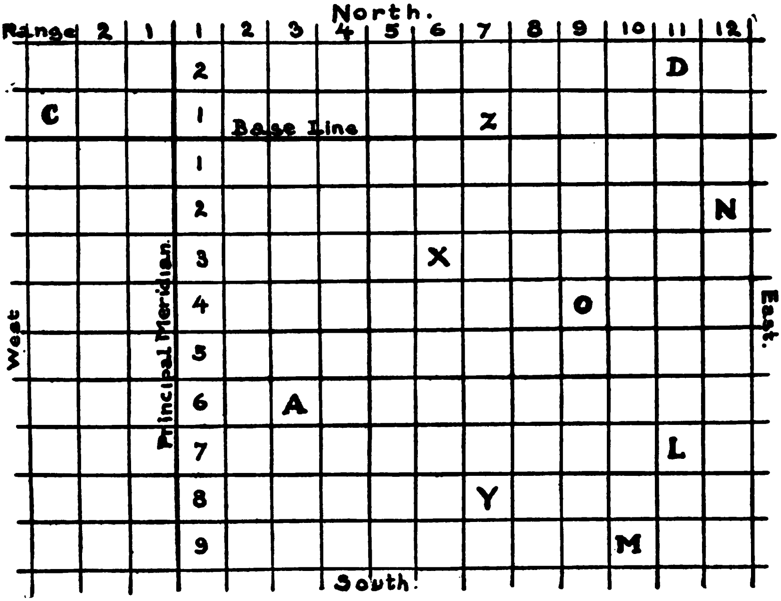
111. How many square rods in a strip a mile long and a rod wide? How many acres?

112. How many acres in a strip a mile long and 3 rd. wide? 24 rd. wide? 160 rd. wide? 320 rd. wide?

How many acres in a square mile?

113. How many acres in a strip ½ mile long and 1 rd. wide? 150 rd. wide? 320 rd. wide?

Government Land — Townships



Townships

114. Land which has belonged to the United States has been laid out in townships 6 miles square.

115. For each state and territory in which there has been such land **a convenient east and west line has been taken as the** *base line,* **and a convenient north and south line as the** *principal meridian.*

116. Townships have been **numbered north and south from the base line.**

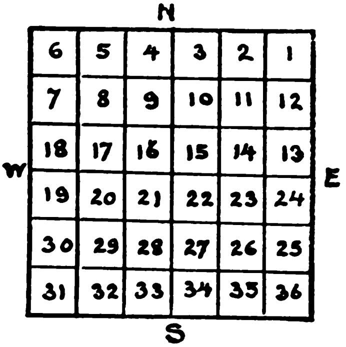
117. Rows of townships north and south are called *ranges,* and are **numbered east and west from the principal meridian.**

Township *A* is 6 south, Range 3 east.

118. What is *L? D? C? O?*

119. What is *M? X? Z? Y?*.

Government Land — Sections — Parts of



6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Sections of Township 6 S, Range 3 E

120. Each township is divided into square miles called *sections*. **How many sections are there in a township?**

121. Beginning with the northeast corner of a township, the sections are numbered west and east as shown in the diagram.

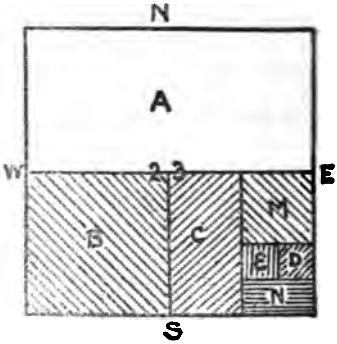
122. Draw a township, divide it into sections, and mark sections 23 and 30.

123. The lower diagram represents section 23 on a larger scale, divided into parts. *B* represents the S. W. quarter of Section 23, Township 6 S., Range 3 E.

124. What does *A* represent?

Make the description as definite and complete as that of *B* above.

125. *N* represents the S. half of the S. E. quarter of the S. E. quarter of Section 23, Township 6 S., Range 3 E. What does *D* represent? What does *E* represent? *M?*

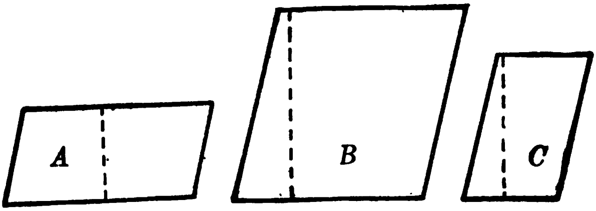


Parts of a Section

126. How many acres in Section 23? In *A? B? C? M? N? D?*

127. Draw section 14 of this township, and divide it into uarters. Shade the N. E. quarter with north and south shade lines. Divide the S. E. quarter into quarters, and shade the N. W. quarter of the S. E. quarter with east and west shade lines.

Rhomboids



Scale $\frac{1}{8}$ in. to 1 rd.

128. How is *A* like a rectangle? How does it differ from a rectangle? Both *A* and the rectangle are called **parallelograms.** Why? **Parallelograms having oblique angles,** like the above, **are called** *rhomboids.*

129. Mark out and cut from paper a rhomboid of the same size and shape as *A*. Draw the dotted line at right angles to two parallel sides as in *A*. Cut the paper along the dotted line and fit the two parts together so as to form a rectangle.

130. How does the area of the rhomboid compare with that of the rectangle?

131. How do the length and width of the rhomboid compare with the length and width of the rectangle?

The area of a rhomboid equals the area of a rectangle of the same length and width.

The side of a parallelogram upon which it is supposed to rest is called the *base,* and the width is called the *altitude.*

It is common to say base and altitude of a parallelogram instead of length and width.

Remember that the altitude is measured at right angles to the base.

132. Measure and find the number of square rods in *A*.

133. In *B*. In *C*.

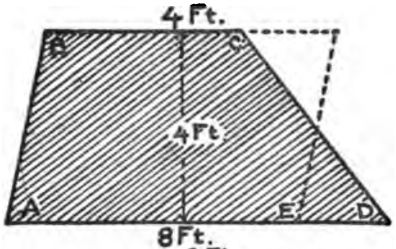
134. How many square rods in a garden in the form of a rhomboid 12 rd. long and $6\frac{3}{4}$ rd. wide?

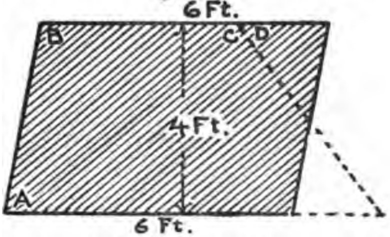
135. How many acres in a field in the form of a rhomboid 20 rd. long and 16 rd. wide?

136. What part of an acre in *A?*

137. How many acres in a field in the form of a rhomboid 32 rd. long and 20 rd. wide?

Trapezoids





138. The figure *ABCD* is a trapezoid. How does it differ from a parallelogram?

139. Draw on paper a trapezoid of the same size and shape as *ABCD*. Letter it inside and cut it out.

140. From the middle point of *CD* draw a line parallel with *AB* and ending in *AD*. Cut along this line and carry *D* round to *C*. What form does this make?

141. How does the area of the parallelogram compare with that of the trapezoid?

142. How does the altitude of the parallelogram compare with that of the trapezoid?

143. What is the sum of the parallel sides of the trapezoid? How does the length of the parallelogram compare with the sum of these sides?

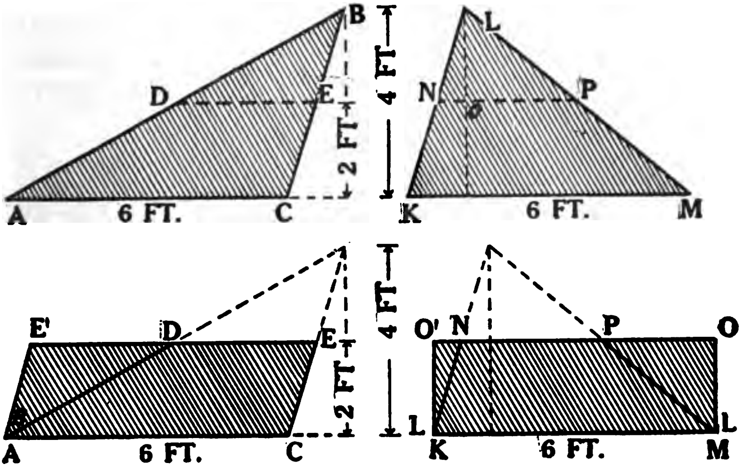
The area of a trapezoid equals that of a rectangle of the same altitude as the trapezoid, with a base equal to half the sum of the parallel sides of the trapezoid.

144. What is the area of the above trapezoid?

145. A field in the form of a trapezoid is 10 rd. wide, one of its parallel sides is 12 rd. long and the other 18 rd. What is half the sum of the parallel sides? How many square rods in the field?

146. If this field were but 8 rd. wide, what would its area be?

Triangles



¼ in. = 1 ft.

147. Draw on paper a triangle of the same shape as *ABC* and another of the same shape as *KLM*.

148. Draw a dotted line from *B* and one from *L* at right angles to the base, or the base continued. These dotted lines represent the greatest widths of the triangles, called their *altitudes*.

149. Draw also the dotted lines *DE* and *NP* parallel to the bases and cutting the altitudes at their middle points. Letter the triangles as in the book.

150. Cut out the triangle *ABC* from your paper. Then cut it on the dotted line *DE* and carry *B* round to *A*.

What form does this make?
How does its area compare with that of the triangle?
How does its base compare with that of the triangle?
How does its altitude compare with that of the triangle?

151. Cut out the triangle *KLM*. Then cut it on the dotted line *NP*, and cut the triangular part on the dotted line of the altitude. Fit these parts to the lower part of the triangle as shown in the figure.

What form does this make?
How does its area compare with that of the triangle?
How does its base compare with that of the triangle?
How does its altitude compare with that of the triangle?

The area of a triangle equals that of a rectangle with the same base and half the altitude.

152. Find the area of *ABC*. Of *KLM*.

153. Find the area of a triangle whose base is 20 rd. and altitude 10 rd. Of one whose base is 16 yd. and altitude 9 yd.

154. Of one whose base is 15 rd. and altitude 12 rd.

155. Of one whose base is 24 rd. and altitude 5 rd.

156. Find the area of the gable end of a house 30 ft. wide and 18 ft. high?

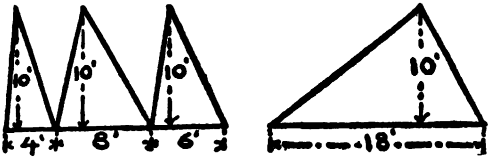
157. Of one side of a hip roof 32 ft. long and 20 ft. from the middle of the lower edge to the apex?

158. The whole roof consists of 4 sides each equal to the above. Find the area of the whole roof.

Circles

159. Find the sum of the areas of the first 3 triangles.

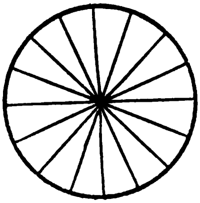
160. Of the triangle at the right.



The area of a number of triangles with equal altitudes equals the area of 1 triangle having the same altitude and a base equal to the sum of the bases of the several triangles.

161. Find the area of the 3 at the left as 1 triangle.

By drawing numerous radii a circle may be divided into a large number of approximate triangles, all having their vertices at the center, and their bases forming the circumference. By increasing the number of these divisions they become practically triangles.



The area of a circle equals the area of the triangles whose united bases form the circumference of the circle and whose common altitude equals the radius.

It is equal to the area of a rectangle whose length equals the circumference and whose width equals half the radius.

162. What is the diameter of the above circle?

163. How long is its circumference?

The circumference equals about 3⅐ times the diameter.

164. How long is half the radius? How many square inches in the circle?

165. The diameter is 4 in. Find the circumference.

166. How much is half the radius? The area?

167. The diameter is 8 in. Find the circumference.

168. How much is half the radius? The area?

Cylinders

Cylindrical Objects

169. A cylindrical can is 7 in. in diameter and 10 in. deep. What is the circumference of a base?

170. What is the area of one base? Of both bases?

In this work it is better to find $\frac{1}{4}$ of 3 × 22 sq. in. than 3 × $\frac{1}{4}$ of 22.

171. If the convex (curved) surface of this cylinder could be unrolled and laid out flat, what would its shape be? How long is the surface? How wide is it?

172. How many square inches in this surface?

173. A cylindrical pitcher is 4 in. in diameter inside and 10 in. deep. What is the inside circumference of the base?

174. What is the area of the base?

175. What is the area of the inside curved surface? Of the whole inside surface?

176. Find the circumference of a base of a cylinder 7 ft. in diameter. Find the area of both bases.

177. The cylinder is 5 ft. high. Find the area of the convex surface. Of the whole surface.

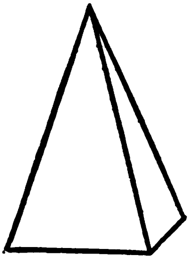
178. Find the circumference of a base of a cylinder 2 in. in diameter and 6 in. high. The area of both bases.

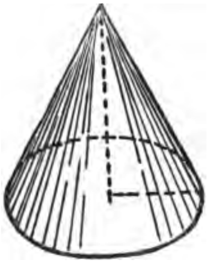
179. Find the area of the convex surface. Of the whole surface.

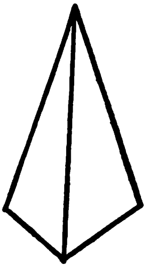
180.* Find the circumference of a circus ring 35 ft. in diameter. The area contained.

181.* Find the area of a circle 14 rd. in diameter.

Pyramids — Cones







182. How many square feet in the sides of a pyramid 7 ft. square whose slant height (altitude of a triangular side) is 20 ft.?

How many of these triangular sides? What is the total length of their bases?

183. How many square feet in the entire surface of this pyramid?

184. How many square feet in the entire surface of a prism of the same base as the pyramid, with an altitude equal to the slant height of the pyramid?

185. Find the area of the entire surface of a pyramid 6 ft. square whose slant height is 12 ft.

186. What is the area of the lateral surface (sides) of a pyramid whose base has 10 sides, each 2 in., and the slant height of whose sides is 10 in.?

187. If the base has 20 sides of 1 in. each, and the slant height is 10 in., what is the area of the lateral faces?

188. If it has 40 sides, each $\frac{1}{2}$ in.? 80 sides, each $\frac{1}{4}$ in.?

189. If it has 160 sides, each $\frac{1}{8}$ in.? 320 sides, each $\frac{1}{16}$ in.?

190. If the circumference of the base of a cone is 20 in. and the slant height 10 in., what is the area of the convex surface?

191. If the diameter of the base is 7 in. and the slant height 10 in. what is the area of the convex surface?

192. What is the area of the base? Of the whole surface?

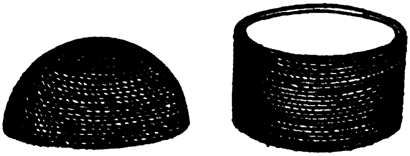
193. What is the area of the convex surface of a cone the diameter of whose base is 14 ft. and whose slant height is 20 ft.?

The convex surface of a cone equals the surface of a rectangle whose length equals the circumference of the base and whose width equals half the slant height of the cone.

194.* Find the area of the convex surface and of the base of a cone whose diameter is 3½ in. and slant height 8 in.

195.* The area of the convex surface and of the base of a cone whose diameter is 21 ft. and slant height 40 ft.

Spheres



196. By winding a string over the surface of a hemisphere and then over the convex surface of a cylinder of the same diameter and height as the hemisphere, we may show that the convex surface of the hemisphere equals that of the cylinder.

197. What does the surface of the other half of the sphere equal?

198. What does the entire surface of the sphere equal?

The area of the surface of a sphere equals the area of the curved surface of a cylinder of the same diameter with an altitude equal to its diameter.

199. Find the area of the surface of a sphere 2 in. in diameter.

200. Find the area of the entire surface of a cylinder of the same dimensions.

201. Find the surface of a sphere 4 in. in diameter.

202. Of a cylinder of the same dimensions.

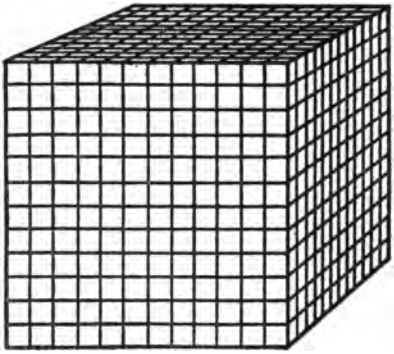
Cubic Inches — Feet — Yards

1. How long is the drawing of the edge of one of the small cubes which make up the large cube at the right?

2. How long is the edge represented by the $\frac{1}{8}$ in. in the drawing? The cube is an inch-cube.

3. How long is the drawing of the edge of the large cube?

4. How long is an edge represented by the $1\frac{1}{2}$ in. in the drawing?



Scale $\frac{1}{8}$. Cubic Foot.

5. How many cubic inches in a row across the foot-cube?

6. How many rows in a layer of inch-cubes?

7. How many cubic inches in 1 layer?

8. How many layers in the foot-cube?
The 12 layers contain 1728 inch-cubes.

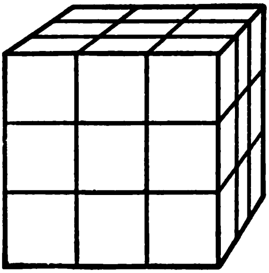
9. How long is the drawing of the edge of one of the small cubes in the second drawing?

10. How long is the edge represented by the $\frac{3}{8}$ in.? This cube is a foot-cube.

11. How many foot-cubes in 1 row?

12. How many in 1 layer?

13. How many in all the layers?

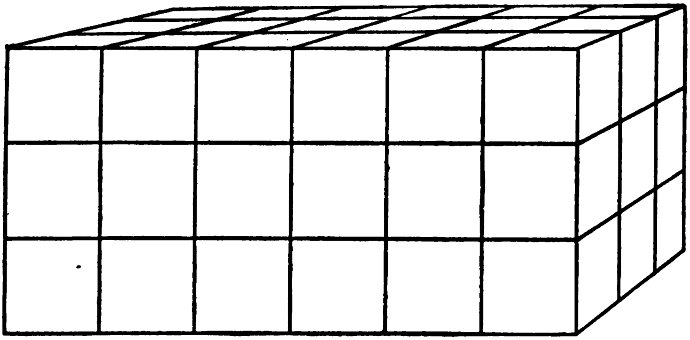


Cubic Yard.
Scale $\frac{3}{8}$ in. to 1 ft.

14. How many cubic feet in 1 cu. yd.?

15. In $\frac{1}{3}$ cu. yd.? In $\frac{2}{3}$ cu. yd.? In $2\frac{1}{3}$ cu. yd.?

Rectangular Solids

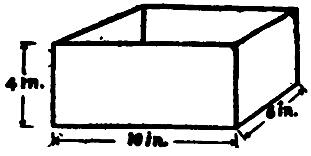


Scale ½.

16. The scale ½ means that the lines of the drawing are ½ as long as the things drawn. How large are the cubes?

17. How many cubes in 1 row along the front? How many rows in 1 layer? How many cubes in 1 layer?

18. How many layers in the solid? How many cubes in the 3 layers?



19. Think of a box 6 in. wide, 10 in. long, and 4 in. deep inside. How many inch-cubes can you place in a row along one side?

20. How many of these rows will make a layer on the bottom of the box?

21. How many inch-cubes in the layer?

22. How many layers would fill the box?

23. How many inch-cubes in all the layers?

24. How many inch-cubes of room in the box?

In learning the following, look at the figure at the top of this page, and think each step as you study it.

To find the amount, or volume, of a space bounded by rectangles, find:

The number of cubes (cubic measures) in 1 row.
The number of rows in 1 layer.
The number of cubes in 1 layer.
The number of layers in all the space.
The number of cubes in all the layers (the whole space, or volume).

25. How many cubic feet of air will a room 10 ft. wide, 15 ft. long and 8 ft. high hold?

26. A room 15 ft. by 20 ft. by 10 ft.?

27. A room 12 ft. by 20 ft. by 10 ft.?

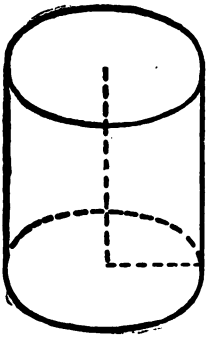
28. A room 16 ft. by 20 ft. by 10 ft.?

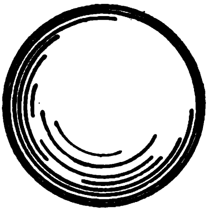
29. Find the volume of a bin 5 ft. by 7 ft. by 1 ft.

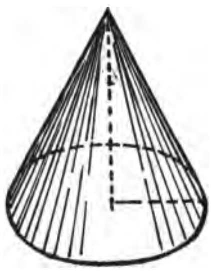
30. Of a bin 5 ft. by 7 ft. by 5 ft.

31. A ton of coal is about 35 cu. ft. How many tons will a bin 5 ft. by 7 ft. by 4 ft. hold?

Cylinders — Spheres — Cones







By measuring with hollow cylinders, cones, and spheres of the same diameter and with an altitude equal to the diameter, **the cylinder is found to hold 3 conefuls of water, and the sphere 2 conefuls.**

32. The volume of a cone equals what part of that of a cylinder of the same diameter and altitude?

33. The volume of a sphere equals what part of that of a cylinder of the same diameter with an altitude equal to the diameter?

The number of cubes in a layer covering the base equals the number of squares in the base.

34. Find the circumference of the base of a cylinder 7 ft. in diameter. Find the number of cubic feet in a layer covering the base.

35. The cylinder is 7 ft. high. Find its volume.

36. A cone of the same diameter and altitude will contain how many cubic feet?

37. Find the volume of a sphere of the same diameter.

38. Find the circumference of a cylinder 4 in. in diameter. Find the number of cubic inches in a layer.

39. The cylinder is 4 in. high. Find its volume.

40. What is the volume of a cone of the same dimensions?

41. Of a sphere of the same diameter?

42.* Find the circumference of a cylinder 6 in. in diameter.

43. How many cubic inches in a layer on the base?

44.* The cylinder is 6 in. high. Find its volume.

For the volume of a cone we may find the volume of a cylinder of the same diameter and $\frac{1}{3}$ as high.

45. What is the circumference of the base of a cone $3\frac{1}{2}$ ft. in diameter?

46. How many cubic inches in a layer on the base?

47. This cone is 6 ft. high. Find its volume.

48. The volume of a sphere equals that of a cylinder of the same diameter with an altitude what part as great as the diameter?

For the volume of a sphere we may find the volume of a cylinder of the same diameter with an altitude $\frac{2}{3}$ as great as the diameter.

49. Find the circumference of a circle 3 in. in diameter.

50. How many cubic inches in a layer on the circle?

51. Find the volume of a sphere of the same diameter.

52. Find the volume of a cone 3 in. in diameter and 3 in. high.

53. Find the volume of a cylinder 2 in. in diameter and 2 in. high.

54. Of a cone 2 in. in diameter and 2 in. high.

55. Of a sphere 2 in. in diameter.

56. Find the volume of a cylinder 4 in. in diameter and 3 in. high. Of a cone of the same dimensions.

Pyramids

57. How does the volume of a cone compare with that of a cylinder of the same base and height?

58. How do you think the volume of a pyramid compares with that of a prism of the same base and height?

By increasing the number of sides of the prism and pyramid indefinitely they become practically cylinders and cones.

59. Find the volume of a pyramid 9 ft. high with a base 4 ft. square.

60. Of a pyramid 30 ft. high with a rectangular base 12 ft. by $8\frac{1}{3}$ ft.

61. Of a pyramid 9 ft. high with a base 3 ft. square.

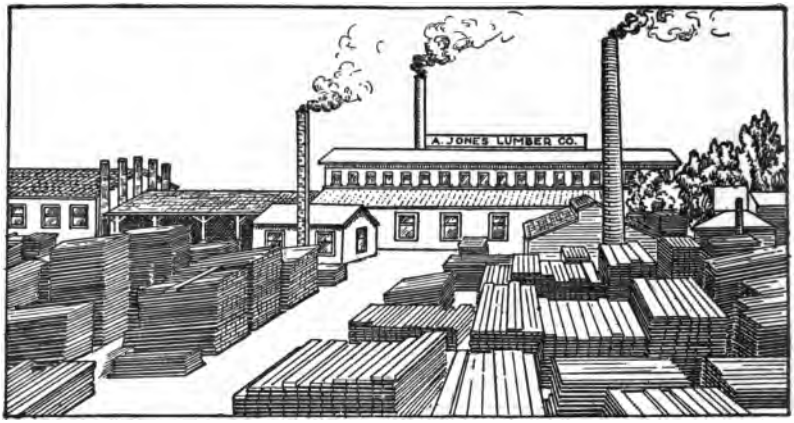
62. Of a pyramid 12 ft. high with a rectangular base $3\frac{1}{2}$ ft. by 4 ft.

63. Of one 30 ft. high with a base 20 ft. square.

64. Of one 15 ft. high with a base 5 ft. square.

65. Of one 12 ft. high with a triangular base having a base 8 ft. long and an altitude of 6 ft.

Lumber — Measure


A. JONES LUMBER CO.

It would be well to get from some one who is erecting a frame building pieces of lumber of as many of the following dimensions as possible: 1 in. (or less) thick and 12 in. wide, 2 in. by 12 in., 2 in. by 4 in., 2 in. by 6 in., 2 in. by 8 in. 3 in. by 12 in., 3 in. by 4 in., 3 in. by 6 in., 3 in. by 8 in., 4 in. by 8 in., and 6 in. by 8 in.

The boys can mark these pieces with pencil and square, and saw them off 1 ft. long.

The pupils should examine the pieces so that they can give their dimensions without measuring.

The quantity of lumber contained in a piece of board a foot square and an inch thick is a board foot. A piece a foot square and 2 in. thick contains 2 board feet. One a foot square and $1\frac{1}{2}$ in. thick contains $1\frac{1}{2}$ board feet. A **piece a foot square and less than an inch thick is also reckoned as a board foot;** but thin boards usually sell at lower prices per foot.

66. A piece of inch board a foot long and 6 in. wide contains what part of a board foot?

67. A piece a foot long and 3 in. wide contains what part of a board foot?

68. A piece a foot long and 9 in. wide?

69. A piece a foot long and 4 in. wide?

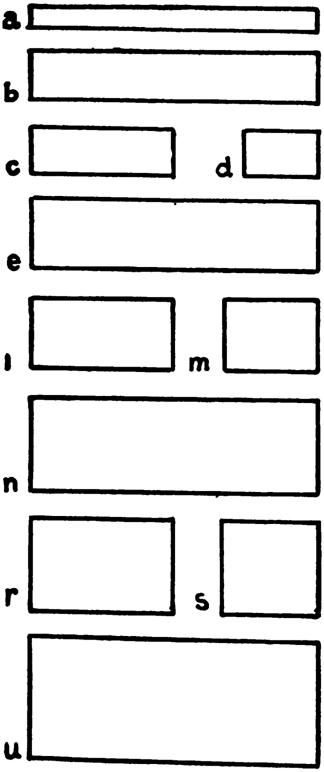
70. A piece a foot long and 8 in. wide?

71. A piece a foot long and 2 in. wide?

72. A piece a foot long and 10 in. wide?

73. How many board feet in a piece a foot square and 2 in. thick? A foot square and $1\frac{1}{2}$ in. thick?

The diagram shows end views of boards and joists. To find width and thickness, measure and use scale. The scale is $\frac{1}{8}$.



How many board feet in a piece of:

74. *a* 1 ft. long? 8 ft. long?

75. *b* 1 ft. long? 8 ft. long?

76. *c* 1 ft. long? 12 ft. long?

77. *d* 1 ft. long? 16 ft. long?

78. *e* 1 ft. long? 14 ft. long?

79. *i* 1 ft. long? 12 ft. long?

80. *m* 1 ft. long? 14 ft. long?

81. *n* 1 ft. long? 26 ft. long?

82. *r* 1 ft. long? 16 ft. long?

83. *s* 1 ft. long? 18 ft. long?

Review these problems.

84.* How many board feet in a sill as thick as *n*, $\frac{2}{3}$ as wide, and 24 ft. long?

85.* In 12 joists, each 2 in. by 3 in. by 8 ft.?

86. How many board feet in a board 1 in. by 6 in. by 8 ft.?

What part of a board foot in a piece 1 in. by 6 in. by 1 ft.?

87. How much will it cost @ \$50 per 1000 ft.?

\$50 per 1000 ft. = xc. per foot.

88. How many feet in a plank 1½ in. by 8 in. by 12 ft.?

89. Find the cost of this @ \$60 per M (1000 ft.).

\$60 per M = xc. per foot.

90. How many feet in a board ½ in. by 8 in. by 12 ft.?

91. Find its cost @ \$45 per M.

\$45 per M = xc. per foot.

92. How many feet in 2 joists, each 6 in. by 6 in. by 28 ft.?

93. Find the cost @ \$30 per M.

94. How many feet in 4 joists, each 2 in. by 6 in. by 10 ft.?

95. Find the cost of 15,000 ft. of lumber @ \$28 per M.

Think this as 10,000 ft. and 5000 ft.

96. How many board feet in joists 2 in. by 4 in. to make 100 ft. in length? Find the cost of this @ \$30 per M.

97. How many board feet in joists 2 in. by 4 in. to make 2 stringers, one above the other, for a fence 100 ft. long?

98. Add 10 ft. to the above for loss in splicing pieces and find the cost @ \$20 per M.

99. How many feet of boards are required to make this fence 3 ft. 6 in. high?

100. Find the cost of these boards @ \$40 per M.

Those who handle and use lumber commonly use the expression "feet," "feet of boards," or "feet of lumber," instead of "board feet."

101. At 2¢ each, what would be the cost of pickets, 5 to 2 running feet, to make the above fence?

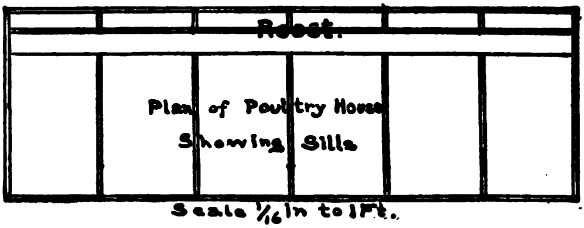
102. How many feet in 2 joists each 2 in. by 8 in. by 18 ft.?

103. Find the cost of these @ \$30 per 1000 ft.

104. Of a plank 2 in. by 8 in. by 6 ft. @ 8¢ per foot.

105. Of a board ½ in. by 8 in. by 8 ft. @ 5¢.

106. Of a board ⅞ in. by 12 in. by 10 ft. @ 7¢.



The sills of a building are the lowest part of the frame, placed horizontally. Those around the outside rest upon the foundation. Those reaching across the building inside are called cross sills.

107. How long are the end sills of this poultry house?

108. How long are the side sills?

109. What is the total length of outside sills?

110. The sills are 3 in. thick and 6 in. wide. There are how many board feet for each foot in length?

111. How many feet of lumber in all outside sills?

112. How much will this lumber cost @ $20 per M?

113. What is the total length of cross sills?

114. These are 2 in. by 4 in. How many board feet in them?

115. How much will this lumber cost @ $20 per M?

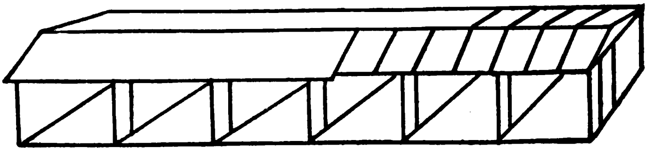
116. There are posts at the corners of the building, at the ends of the cross sills, one for a gate on each cross sill, and 2 at the right end of the building for a doorway. How many are there in all?

117. The posts are 2 in. by 4 in. and 5 ft. 6 in. long. But joists come in such lengths that we must reckon 6 ft. of length of post in finding the cost. How many feet of lumber must be bought for each post?

118. How many for all the posts?

119. How much would this cost @ $20 per M?

120.* How many feet in 6 joists each 2 in. by 6 in. by 8 ft.? Find their cost @ $25 per 1000 ft.



The plates of a building are the parts of the frame which rest upon the posts and support the roof. In this building they are of the same number and size as the outside sills. The ties correspond to the cross sills, and are of the same number and size.

121. The rafters are the roof frame. Their lower ends rest upon the plates. In this building they are 3 ft. apart, from the middle of one to the middle of the next. Two rafters, one on each side, form a pair. How many pairs of rafters would be needed if the building were only 3 ft. long? If it were 6 ft. long? 9 ft. long? 12 ft. long? How many pairs does this building require?

122. Each pair has a rafter 8 ft. long for the front part of the roof, and one 12 ft. long for the back side. What is the total length of the 17 pairs of rafters?

123. They are 2 in. by 6 in. How many feet of lumber in them?

124. Boards on the sides and ends of this building are laid vertically. The common lengths of boards are 8 ft., 10 ft., 12 ft., 14 ft., and 16 ft. What length should be used for the rear side of the building to make the waste as small as possible?

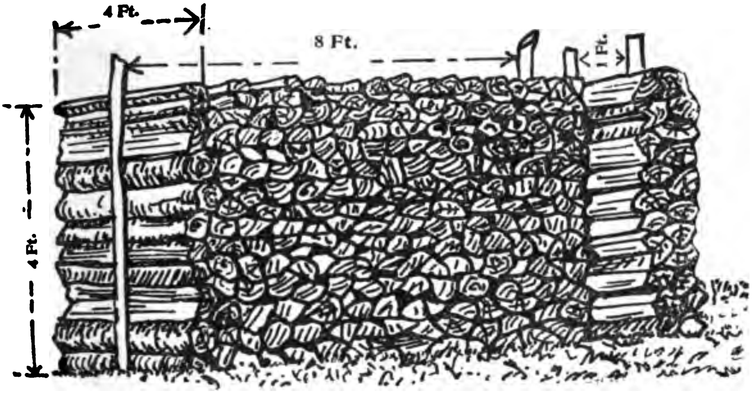
125. What is the total width of boards required for that side?

126. How many board feet are required?

127. The ridge of the roof is 2 ft. above the plate. How long are the longest boards required on the ends? How long are the shortest?

128. How long boards should be selected for the ends, that each may make one of the longest and one of the shortest required?

Wood Measure


4 Ft.
8 Ft.
1 Ft.
4 Ft.

129. In the illustration the wood is shown to have been cut into how long pieces?

Wood intended for market is usually cut 4 ft. long.

130. How wide is the pile of wood at the left?

131. How long is it?

132. How high is it?

A quantity of wood equal to a pile 4 ft. wide, 4 ft. high, and 8 ft. long is a *cord.*

133. How wide is the smaller pile shown at the right? Think the width of this pile in the same direction as the width of the cord.

134. How long is the smaller pile?

135. How high is it?

A quantity of wood equal to a pile 4 ft. wide, 4 ft. high, and 1 ft. long is a *cord foot.*

136. How many cord feet equal 1 cord?

137. How many cubic feet equal a cord foot? A cord?

16 cubic feet = **1 cord foot** (cd. ft.)
8 cord feet (128 cubic feet) = **1 cord**

138. What are the dimensions of a cord of wood?

How many cords in a pile of wood:

139. 4 ft. wide, 4 ft. high, and 16 ft. long?

How many piles 8 ft. long does this equal?

140. 4 ft. wide, 4 ft. high, and 12 ft. long?

141. 4 ft. wide, 4 ft. high, and 24 ft. long?

142. 4 ft. wide, 4 ft. high, and 20 ft. long?

143. 4 ft. wide, 4 ft. high, and 32 ft. long?

144. 4 ft. wide, 4 ft. high, and 28 ft. long?

145. 4 ft. wide, 4 ft. high, and 40 ft. long?

146. 4 ft. wide, 4 ft. high, and 36 ft. long?

147. 4 ft. wide, 4 ft. high, and 48 ft. long?

148. 4 ft. wide, 8 ft. high, and 8 ft. long?

149. What part of a cord is a pile of wood 4 ft. wide, 4 ft. high, and 4 ft. long? How many cord feet in it?

150. What part of a cord is a pile 4 ft. wide, 4 ft. high, and 6 ft. long? How many cord feet in it?

151. What part of a cord is a pile 4 ft. wide, 4 ft. high, and 5 ft. long? How many cord feet in it?

152. What part of a cord is a pile 4 ft. wide, 4 ft. high, and 7 ft. long? How many cord feet in it?

153. How many cords in a pile 4 ft. wide, 4 ft. high, and 56 ft. long?

154. In a pile 4 ft. wide, 8 ft. high and 8 ft. long?

155. In a pile 4 ft. by 6 ft. by 8 ft.?

156. In a pile 4 ft. by 6 ft. by 16 ft.?

A pile 4 ft. by 4 ft. by 16 ft. = x cd. A pile 4 ft. by 6 ft. by 16 ft. = x cd.

157. In a pile 4 ft. by 6 ft. by 24 ft.?

158. In a pile 4 ft. by 5 ft. by 8 ft.?

159. In a pile 4 ft. by 5 ft. by 16 ft.?

160. In a pile 4 ft. by 5 ft. by 40 ft.?

161. In a pile 4 ft. by 7 ft. by 8 ft.?

Liquid Measure

4 gills (gi.) = 1 pint (pt.)
2 pints = 1 quart (qt.)
4 quarts = 1 gallon (gal.)

1 gallon = 231 cubic inches
$7\frac{1}{2}$ gallons (nearly) = 1 cubic foot
1 cupful = about 1 half pint

162. A 2-gallon can of milk would fill how many quart jars?

163. 2 quarts = x half pints.

164. A half pint is what part of a quart? Find the cost of a half pint of cream at 40¢ a quart.

165. Of 2 qt. of kerosene at 16¢ a gallon.

166. Of 1 qt. of vinegar at 20¢ a gallon.

167. Of 5 gal. of gasoline at 20¢ a gallon.

168. A glass of milk is about a half pint. How many glasses will a quart fill?

169. For how much could you sell a pint of milk at 5¢ a glass?

170. What part of a gallon is 2 qt.?

171. Find the cost of 2 qt. of molasses at 60¢ a gallon.

172. Of a pint of vinegar @ 20¢ a gallon.

173. How many cupfuls in a gallon?

174. About how many quarts equal a cubic foot?

175. A tank 2 ft. by 3 ft. by 2 ft. will hold about how many gallons?

176. How many quarts?

177. For how much will a gallon of milk sell @ 5¢ a glass?

178. If a runabout will run 20 miles on a gallon of gasoline, how far will it run on a full tank of gasoline measuring 1 ft. by 1 ft. by 1 ft.?

179. Find the cost of 1 qt. of molasses @ 75¢ a gallon.

180. Of 3 qt. Of 6 qt. Of $2\frac{1}{2}$ gal.

181. Of 3 pt. of milk a day for January @ 9¢ a quart.

Dry Measure

2 pints = 1 quart
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)

In measuring grains the measures should be even full.

In measuring fruits and vegetables the measures should be heaped.

An even bushel equals about $1\frac{1}{4}$ cubic feet, a heaped bushel about $1\frac{1}{2}$ cubic feet.

182. How many quarts in a measured bushel?

183. George's chickens eat 3 pints of wheat per day. How many days will a measured bushel last them?

184. How many pints in $1\frac{1}{2}$ pk.?

185. What part of a bushel of peaches will a crate 1 ft. wide, 2 ft. long, and 6 in. deep hold?

186. What part of a measured bushel of corn would a box of the same dimensions as the above crate hold?

187. How much is gained in buying a bushel of potatoes for $1, and selling them @ 20¢ per half peck?

188. How much in buying a half bushel crate of peaches for $1 and selling them at 35¢ per half peck?

189. If potatoes can be bought @ $1.50 per bushel or @ $5 per barrel of 11 pecks, which is cheaper? How much?

190. If a horse eats 8 qt. of oats a day, how many measured bushels would he eat in a week?

191. A box 2 ft. by 4 ft. by 3 ft. will hold how many measured bushels of oats?

192. How many bushels would a box 2 ft. wide, 2 ft. long, and $2\frac{1}{2}$ ft. deep hold?

193. A bushel of potatoes equals how many cubic feet?

194. How many measured bushels of potatoes will a bin 2 ft. wide, 6 ft. long, and 3 ft. deep hold?

195. How many bushels of onions will a box 2 ft. square and $1\frac{1}{2}$ ft. deep hold?

Measures of Avoirdupois Weight

16 ounces (oz.) = **1 pound** (lb.)
2000 pounds = **1 ton** (T.)
2240 pounds = **1 long ton**

The long ton is used in selling coal at wholesale and computing duties.
60 pounds of wheat or potatoes = 1 bushel
56 pounds of corn or rye = 1 bushel
32 pounds of oats = 1 bushel
196 pounds of flour = 1 barrel
200 pounds of beef or pork = 1 barrel
A ton of coal occupies about 35 cubic feet.
A cubic foot of air weighs about 1 ounce.
A cubic foot of water weighs about 1000 ounces, or 62½ pounds.

1. What part of a pound is 1 oz.? 3 oz.? 5 oz.? 13 oz.? 15 oz.?

2. What part of a pound is 8 oz.? 4 oz.? 12 oz.?

3. 2 oz.? 6 oz.? 10 oz.? 14 oz.?

4. Find the cost of 4½ lb. of squash @ 3¢.

5. How much per ounce is 16¢ per pound? 32¢ per pound?

6. Find the cost of 6 lb. 3 oz. of beef @ 16¢.

7. Of 2 lb. 5 oz. of steak @ 32¢.

8. How much per ounce is 24¢ per pound? 20¢ per pound? 28¢?

9. Find the cost of 3 lb. 3 oz. of mackerel @ 24¢.

In answers count a half or larger part of a cent as a whole cent, and a part less than a half as nothing.

10. Find the cost of 5 lb. 1 oz. of fowl @ 20¢.

11. Of 10 lb. 5 oz. of chicken @ 28¢.

How much more than $\frac{1}{4}$ lb. is 5 oz.? How much will the $\frac{1}{4}$ lb. cost? 1 oz.?

12. Of 1 lb. 3 oz. of butter @ 40¢.

13. Of $1\frac{3}{8}$ lb. of pork @ 20¢.

14. Of 5 lb. 7 oz. of swordfish @ 22¢.

15. Of 1 lb. 3 oz. of mercury @ 80¢.

16. Of 5 lb. 11 oz. of lamb @ 28¢.

17. Of 6 lb. 7 oz. of lamb @ 18¢.

18. Of 1 lb. 9 oz. of lamb chops @ 25¢.

19. Of 4 lb. 2 oz. of chicken @ 30¢.

20. Of 3 lb. 6 oz. of chuck @ 15¢.

21. Of 2 lb. 10 oz. of halibut @ 24¢.

22. Of 1 lb. 14 oz. of rump steak @ 30¢.

What part of a pound is 14 oz.? It lacks what part of being a pound?

23. Of 2 lb. 2 oz. of round @ 22¢.

24. Of 4 lb. 5 oz. of fowl @ 22¢.

25. Of $15\frac{1}{8}$ lb. of turkey @ 32¢.

26. Of $5\frac{1}{4}$ lb. of squash @ 5¢.

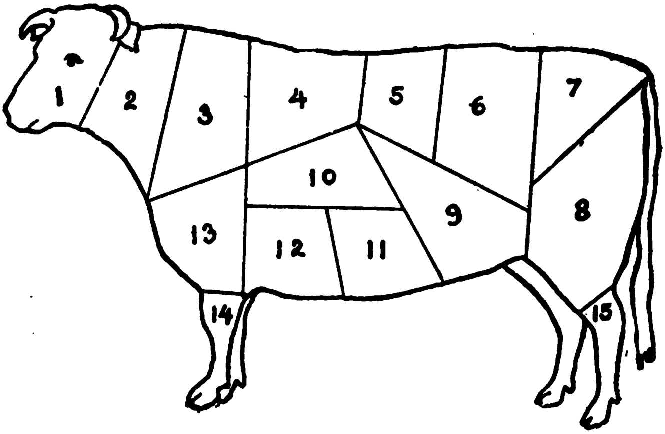
27.* Of 5 lb. 9 oz. of pork @ 18¢. Of 3 lb. 14 oz. of cod @ 18¢.

28.* Of 5 lb. 2 oz. of corned brisket at 21¢.

29.* Of 4 lb. 11 oz. of cod @ 14¢.

30.* Of 6 lb. 10 oz. of lobster @ 28¢.

31.* Of 8 lb. 3 oz. of lobster @ 30¢.



This diagram shows into what pieces beef is cut; and the names of these parts, their approximate weights and retail prices are indicated below.

1. Head, 15 lb. @ 6c.
2. Neck, 25 lb. @ 8c.
3. Chuck, 135 lb. @ 10c. to 16c.
4. Prime ribs, 60 lb. @ 19c.
5. Porter-house steak, 80 lb. @ 30c.
6. Sirloin steak, 35 lb. @ 28c.
7. Rump steak, 30 lb. @ 28c.
8. Round, 130 lb. @ 18c. to 24c.
9. Flank, 30 lb. @ 9c.
10. Short ribs, 25 lb. @ 10c.
11. Plate, 80 lb. @ 9c.
12. Brisket, 75 lb. @ 15c.
13. Shoulder clod, 60 lb. @ 16c.
14. Shin, 40 lb. @ 7c.
15. Shank, 22 lb. @ 6c.

At the prices indicated above find the cost:

32. Of 6 lb. 8 oz. of brisket.

33. Of 4 lb. 9 oz. of shank.

34. Of 2 lb. 7 oz. of sirloin steak.

35. Of 5 lb. 12 oz. of prime ribs.

36. Of 1 lb. 13 oz. of porter-house steak.

37. Of 4 lb. 11 oz. of chuck @ 12¢.

38. Of 6 lb. 5 oz. of rump for pot-roast.

39. Of 2 lb. 3 oz. of round for pot-roast @ 20¢.

40. Of 2 lb. 2 oz. of butter @ 35¢.

Postage

In United States Territory, Canada, Mexico, and Direct to Some Other Foreign Countries

The rates to most other foreign territory are higher than those given below.

ON FIRST-CLASS MATTER, *including letters, sealed packages, and packages containing written matter other than the name of the sender*, the rate is **2¢ per ounce or fraction of an ounce.**

41. How much is the postage on a letter weighing ½ oz.?

42. On a sealed package weighing 9 oz.?

43. On a letter weighing 2¼ oz.?

44. On a written report weighing 7½ oz.?

45. On a box of candy weighing 1 lb. with a written note inclosed?

46. On a sealed package weighing 5 oz.?

47. On a letter weighing 1¾ oz.?

ON SECOND-CLASS MATTER, *including newspapers and periodicals*, the rate is **1¢ per pound or fraction of a pound when sent by the publisher or a news-agent,** and **1¢ for each 4 oz. or part of 4 oz. when sent by another** to one address.

48. How much is the postage on 600 lb. of newspapers sent by the publisher?

49. On 2 lb. 3 oz. of magazines sent by a news-agent?

50. On 2 lb. 3 oz. of magazines sent by you to one address?

51. On 50 lb. of newspapers sent by a news-agent?

52. On ½ lb. of newspapers sent by you to one address?

53. On a magazine weighing 1 lb. sent by you?

54. On a magazine weighing 12 oz. sent by you?

55. On a magazine weighing 1 lb. 4 oz., forwarded by a postmaster?

ON BOOKS, *in parcels weighing not more than* 8 *ounces*, the rate is **1¢ for each 2 ounces or fraction of 2 ounces.**

ON MERCHANDISE, *other than newspapers, periodicals, and books, in parcels weighing not more than* 4 *ounces*, the rate is **1¢ for each ounce or fraction of an ounce.**

56. How much is the postage on a parcel of books weighing 2 oz.? On one weighing 4 oz.?

57. On one weighing 1 oz.? On one weighing $1\frac{1}{2}$ oz.?

58. On one weighing 5 oz.? On one weighing $4\frac{1}{2}$ oz.?

59. On one weighing $5\frac{1}{2}$ oz.? On one weighing 6 oz.?

60. On a parcel containing a handkerchief weighing 1 oz.? On one weighing $1\frac{1}{2}$ oz.?

61. On one weighing 2 oz.? On one weighing 3 oz.?

62. On one containing gloves weighing $3\frac{1}{2}$ oz.?

63. On one weighing $2\frac{1}{2}$ oz.? On one weighing 4 oz.?

ON PARCEL POST MATTER, *all merchandise not included in the preceding classes*, the rates are as indicated below.

On parcels delivered from the office in which they are deposited the rate is **5¢ for 1 pound or less and 1¢ for each additional 2 pounds or fraction of 2 pounds up to 50 pounds.**

On parcels sent to another office not more than 150 *miles away* the rate is **5¢ for 1 pound and 1¢ for each additional pound or fraction of a pound up to 50 pounds.**

No parcel containing anything dangerous or injurious or perishable within the time required for transporting and delivering it and no parcel whose length and girth combined exceeds 72 in. can be sent through the mail.

64. How much is the postage on a parcel of cloth weighing 3 lb. delivered from the office in which it was deposited?

How much is it for the first pound? How much for the 2 additional pounds? How much would 1 additional pound cost?

65. How much is the postage on a parcel of books weighing 5 lb. delivered from the office in which it was deposited?

How much is it for the first pound?
How many additional 2 pounds are there?
How much do these cost? How much for all?

66. How much is the postage on a parcel weighing 6 lb. delivered from the home office (the office in which it was deposited)?

67. How much is the postage on a parcel weighing 40 lb. delivered from the home office?

68. On a 2-ounce parcel containing merchandise?

69. On a 12-pound parcel sent 100 miles?

70. On a 34-pound parcel sent 125 miles?

71. On a 47-pound parcel sent 90 miles?

72. On a 7-pound parcel sent 40 miles?

Parcels sent longer distances must not weigh more than 20 *pounds. The rates are as follows:*

Miles Sent	*First Pound*	*Each Additional Pound*
150–300	$ .06	$ .02
300–600	.07	.04
600–1000	.08	.06
1000–1400	.09	.08
1400–1800	.11	.10
Over 1800	.12	.12

73. How much is the postage on a 4-pound parcel sent 250 miles?

74. On a 9-pound parcel sent 400 miles?

75. On a 12-pound parcel sent 500 miles?

76. On a 18-pound parcel sent 700 miles?

77. On a 17-pound parcel sent 1100 miles?

78. On a 14-pound parcel sent 1500 miles?

79. On a 20-pound parcel sent 1900 miles?

80. On a 12-ounce parcel sent 2800 miles?

FOR REGISTERED MATTER the cost is **10¢ in addition to the regular postage.**

FOR SPECIAL DELIVERY letters or packages the rate is **10¢ in addition to regular postage.**

81. How much is the postage on a registered letter weighing 1 oz.?

82. On a special delivery 7-ounce sealed parcel?

83. On a registered parcel of dry goods weighing 29 oz. sent 200 miles?

84. On a registered parcel of books weighing 1 lb. 13 oz. sent 1300 miles?

85. On a registered package of magazines, sent by you and weighing 1 lb. 13 oz.?

86. On a 5-pound registered parcel sent 180 miles?

87. On a special delivery 9-pound parcel sent 40 miles?

88. On a special delivery 3-pound parcel sent 90 miles?

Tons

2000 pounds = 1 ton (T.)

89. What part of 1 T. is 1000 lb.? 500 lb.? 1500 lb.?

90. 400 lb.? 800 lb.? 1200 lb.? 1600 lb.? 200 lb.?

91. Find the cost of 1000 lb. of coal @ $8 per ton.

92. Of 500 lb. Of 1500 lb.

93. Of 1500 lb. of hay @ $20. Of 200 lb.

94. Of 200 lb. of straw @ $15. Of 1600 lb.

What part of a ton is 200 lb.? What part of $15 will it cost?

95. Of 1500 lb. of coal @ $8.50. Of 750 lb.

96. Of 1000 lb. coal @ $8.25. Of 200 lb.

97. Of 600 lb. Of 1200 lb.

98. Of 1600 lb. Of 1400 lb.

99. Of 250 lb. @ $8. Of 750 lb. Of 1250 lb.

What part of 1000 lb. is 250 lb.? What part of 2000 lb.? What part of a ton is 750 lb.? What part is 1250 lb.?

Seconds

To the Teacher: Some classes might take this exercise as a home lesson; but perhaps it would ordinarily be better to select one pupil to perform each experiment, and require the others to observe carefully and report.

1. Tie one end of a piece of thread 4 ft. long around a small pebble. Taking the thread between the thumb and finger of the left hand about a foot from the pebble, hold it steadily in front of you. With the right hand draw the pebble about 2 in. to the right, and let it go.

Notice the swings from side to side, and count 10 of them.

2. Take the thread 2 feet from the pebble, and try the same thing, noticing whether it swings faster or more slowly.

3. Take the end of the thread, and try the same thing, noticing the rate of swinging.

4. How does lengthening the distance of the pebble from the fingers affect the time of swinging?

5. How does shortening the distance affect the time of the swinging?

6. Hold the thread so that the middle of the pebble will be $39\frac{3}{8}$ in. below your fingers. Draw the pebble about 4 in. aside, and notice the swings. Try it again and count the swings for a minute.

7. Draw the pebble about 6 in. to the right, and count the swings for a minute. Does the longer swing have much effect upon the time of the swing?

8. About how long time does one of these swings take?

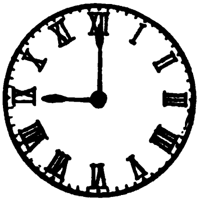
9. Let the pebble swing again as in 6, and count the swings, trying to fix the time of the swings in mind.

10. Let each pupil close his eyes, and try to count 60 silently in 60 seconds, raising his hand without opening his eyes at the end of his counting.

11. How many seconds in $\frac{1}{2}$ minute? In $\frac{1}{4}$ minute? In $\frac{3}{4}$ minute?

12. How many minutes in $\frac{1}{2}$ hour? In $\frac{1}{4}$ hour? In $\frac{3}{4}$ hour? In $\frac{2}{3}$ hour?

Telling Time — Hours



A

13. The face of the clock is also called the **dial.** Beginning with I on the dial *A*, read in order the numbers toward the right to XII.

Toward the right in a circle means to the right in the upper, or farther, side of the circle.

14. Write these numbers in order with figures.

15. Do the hands of the clock turn toward the right, or toward the left?

16. When the short hand of the clock points to IX, it is about 9 o'clock. When it points to XII, it is what time? When it points to II? To V?

The short hand tells the hour. It is the *hour-hand.*

17. How long does it take the hour-hand to turn from XII around to XII again?

New days begin at midnight.

The hour-hand begins a new turn round the face of the clock at midnight and finishes it at noon.

It keeps right on with another turn and finishes it at midnight.

18. How many hours are there from midnight to noon? From noon to midnight? From midnight to midnight?

The time from midnight to noon is the **forenoon,** or **morning.** "9 o'clock A.M." means 9 o'clock in the forenoon.

The time from noon to midnight is **afternoon,** or **evening.** "6 P.M." means 6 o'clock in the afternoon.

How many hours from:

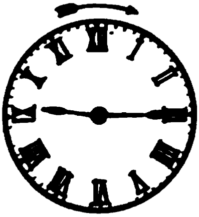
19. 2 A.M. to 11 A.M.? 1 P.M. to 10 P.M.?

20. 11 A.M. to 1 P.M.? 6 A.M. to 2 P.M.?

How many hours from 11 A.M. to noon? From noon to 1 o'clock?

21. 9 A.M. to 4 P.M.? 6 A.M. to 9 P.M.?

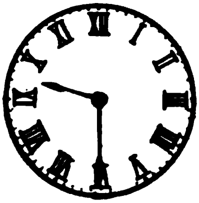
Quarters — Halves



B

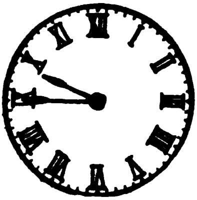
22. To what hour does the hour-hand on dial *B* point? Is it just at the hour, or a little past the hour?

23. We cannot tell by the hour-hand just how many minutes past the hour it is. But the long hand moves from XII round to XII again in an hour. It points to XII just when an hour is finished and a new hour begins. What part of the way round has this hand moved? What part of an hour past nine is it? Toward what does the long hand point at quarter past the hour?



C

24. In *C* the hour-hand shows time between what hours? The long hand has moved what part of the way round from XII to XII? What part of an hour past nine is it? Toward what does the long hand point at half past the hour?



D

25. The long hand in *D* has moved what part of the way round from XII to XII? What part of an hour past nine is it? Toward what does the long hand point at three quarters past the hour?

26. At that time it lacks what part of an hour of 10 o'clock?

When the long hand points to III, it is a quarter past the hour.

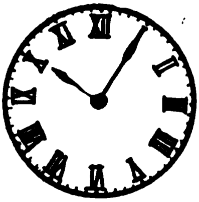
When it points to VI, it is half past the hour.

When it points to IX, it is three quarters past the hour, or a quarter of the hour.

27. What time is it when the hour-hand points between VI and VII and the long hand points to IX? To III? To VI?

Minutes

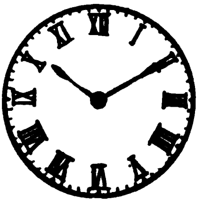
28. How many minutes in an hour? In ½ hour? In ¼ hour? In ¾ hour?



E

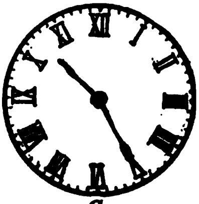
29. Toward what does the long hand point when it is 15 minutes past the hour? When it is 30 minutes past the hour? When it is 45 minutes past?

30. In *E* the long hand has moved over what part of the way from XII to III? It is what part of 15 minutes past the hour? A third of 15 minutes is how many minutes? How many minutes past the hour is it by *E?*



F

31. In *F* the long hand has moved over what part of the way from XII to III? It is what part of 15 minutes past the hour? Two-thirds of 15 minutes are how many minutes? How many minutes past the hour is it by *F?*

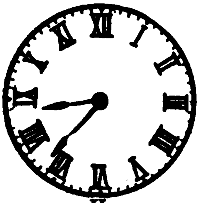


G

It takes the long hand 5 minutes to move from one number to the next on the dial.

32. In *G* it is how many minutes past the hour?

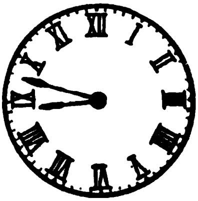
The long hand tells the number of minutes past the hour, and is called the *minute-hand.*



H

33. If the minute-hand points to VII, it is how many minutes past the hour?

34. In *H* it is how many minutes past the hour? Past what hour?



I

35. If the minute-hand points to X, it is how many minutes past the hour? By dial *I* it is how many minutes past?

Hours — Minutes

36. What time is it by dial *C?* By dial *B?*

Tell the time past the hour and the hour.

How long does it take a pupil to walk to school if he starts at:

37. 8.30 and arrives at 8.37?

38. 8.41 and arrives at 8.47?

39. 8.44 and arrives at 8.50?

40. 8.46 and arrives at 8.54?

At what time does a pupil reach school if he starts at:

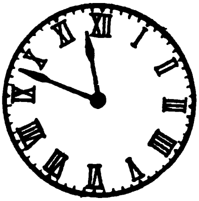
41. 8.21 and is 6 minutes on the way?

42. 8.25 and is 4 minutes on the way?

43. 8.19 and is 5 minutes on the way?

44. 8.18 and is 6 minutes on the way?

45. What time is it when the hour-hand is between V and VI and the minute-hand at the third dot beyond I?



46. What time is indicated by the clock-face shown here?

47. An arithmetic exercise began at 9.45 and closed at 10.08. How much time did it take?

48. The reading lesson occupies 25 min., the writing 20 min., and the geography 30 min. How many hours are used in these exercises?

49. Frank worked from 7.30 A.M. to 12 @ 10¢ an hour. How much did he earn?

50. Between 8.40 and 10.10 Maurice gathered and cut up 3 baskets of driftwood. How long did he work?

51. He received 5¢ per basket for the wood. How much did he earn per hour?

52. It is now 2.45 P.M. The train goes at 3.28. How many minutes before it leaves?

Days — Weeks — Months

53. It is 22 min. on the way. Arrives when?

54. Arthur went to bed at 8.30 P.M. and got up at 6.45 A.M. How many hours was he in bed?

55. James hired a boat from 3.15 to 4.45 @ 25¢ per hour. For how many hours did he hire it? How much did it cost?

56. The tide began to rise at 12.12 and kept rising till 6.24. How long did it rise?

57. An excursion steamer sailed at 10 A.M. and returned at 8.20 P.M. How many hours was she gone?

58. Between 8 o'clock and 11 Helen picked 24 baskets of blackberries. How many baskets per hour did she pick?

59. A woman works from 8.40 o'clock until 12 @ 22¢ per hour. How much does she earn?

60. A carpenter works from 8.30 to 4.40, less 1 hour at noon, @ 50¢ an hour. How much does he earn?

61. Beginning with the first, write in order the names of the days of the week.

62. How many days is it from Sunday to Tuesday?

63. From Sunday to Friday?

64. From Saturday to Wednesday?

65. From Wednesday to a week from the next Friday?

66. **"Thirty days hath September,**
April, June, and November."

Each other month excepting February has 31 days.

How many days in April and May?

67. How many in June and July? In July and August?

68.* In December, January, and March?

69.* In April, June, September, and November?

70.* In August, September, and October?

Months — Days

71. **February has 28 days in a common year, and 29 days in leap year.** The years 1910 and 1911 are common years. How many days in February and March, 1911?

72. The year 1912 and every fourth year from that until the year 2100 are leap years. Name the leap years from 1912 to 1960.

73. How many days in February and March, 1912?

74. In January and February, 1916? In January and February, 1913?

75. Beginning with the first, write in order the names of the months of the year, with the number of days this year in each after the name.

76. How many in March, April, and May?

Fix the spelling of all words in these exercises.

77.* How many days in June, July, and August?

78.* In September, October, and November?

79.* In January and September?

80. How many days from Aug. 10 to Sept. 12? How many to Sept. 10?

81. From Sept. 10 to Oct. 12?

82. If the first day of November is Monday, the 8th is what day of the week? The third Monday is what day of the month? The fourth? The fifth?

83. The first day of December is what day of the week? The 22d is what day of the week?

84. Christmas will be what day of the week? New Year's day will be what day of the week?

85. Amy reads 25 pages an hour. How many hours will it take her to read a book of 300 pages?

86. A touring car going 20 miles an hour averages a mile in how many minutes?

87. It averages a half mile in how many minutes?

88.* A car went 6 miles in 10 min. It averaged a mile in how many minutes? In how many seconds?

89.* It averages a half mile in how many seconds? A fourth of a mile in how many? An eighth of a mile?

90. How long is the day when the sun rises at 6.09 and sets at 6.09?

91. When it rises at 4.22 and sets at 7.39?

92. $\frac{1}{4}$ h. $= x$ minutes $\frac{3}{4}$ h. $= x$ minutes

93. $\frac{1}{3}$ h. $= x$ minutes $\frac{2}{3}$ h. $= x$ minutes

94. $\frac{3}{4}$ min. $= x$ seconds $\frac{2}{3}$ min. $= x$ seconds

95. Frank studied history from 7.25 to 8.10. How many minutes did he study?

96. $\frac{1}{5}$ min. $= x$ seconds $\frac{2}{5}$ min. $= x$ seconds

97. $\frac{1}{6}$ d. $= x$ hours $\frac{5}{6}$ d. $= x$ hours

98. 2 centuries $= x$ decades A decade $= x$ months.

99. 2 centuries + 3 decades $= x$ years.

100. $\frac{3}{4}$ century $= x$ years.

101.* A teacher's salary is $600 for a year of 40 wk. How much should she receive for teaching 3 wk. and 1 d.?

102. A teacher's salary is $800 for a year of 40 weeks. How much is it for 10 weeks?

Time between Two Dates

Find the time from Jan. 6, 1907, to Aug. 24, 1910.

a. From Jan. 6, 1907, to Jan. 6, 1910, is how many years?

b. From Jan. 6, 1910, to Aug. 6, 1910, is how many months?

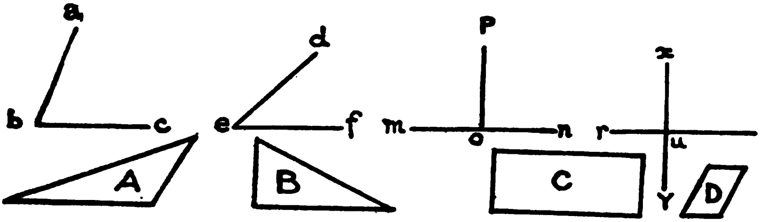
c. From Aug. 6, 1910, to Aug. 24, 1910, is how many days?

d. The whole time from Jan. 6, 1907, to Aug. 24, 1910, is how many years, months, and days?

To find the time between two dates, find:
The number of entire years.
The number of entire months remaining.
The number of days remaining.

Find the time from:

103. Jan. 10, 1912, to June 22, 1913.
104. June 12, 1912, to Sept. 20, 1914.
105. Oct. 9, 1910, to Jan. 16, 1913.
106. April 7, 1912, to June 5, 1914.
107. May 3, 1912 to June 3, 1914.
108. Sept. 12, 1912, to Dec. 5, 1913.
109. April 19, 1775, to Oct. 19, 1781.
110. April 12, 1861, to April 26, 1865.
111. June 1, 1913, to May 10, 1914.
112. Dec. 10, 1913, to May 5, 1914.
113. Jan. 12, 1913, to Feb. 28, 1914.
114. Sept. 9, 1912, to Jan. 1, 1914.
115. Oct. 30, 1911, to Feb. 15, 1914.
116. Dec. 18, 1911, to June 7, 1913.
117. Aug. 3, 1492, to the present day.
118. July 4, 1776, to the present day.
119. Dec. 21, 1620, to the present day.
120. The day of your birth to the present day.



1. Do the lines *ba* and *bc* above extend in the same direction, or in different directions from the same point?

The difference in direction of two lines extending from a point is an angle.

The lines which form the angle are its **sides.**

The point from which they extend is its **vertex.**

2. How many angles are shown above?

3. Which have the greater difference in direction, those extending from *e*, or those extending from *b*?

4. Which of these is the greater angle?

5. Name 2 angles having their vertices at the same point and one side in common.

6. The angle having its vertex at *b* is read *abc*. How is the angle having its vertex at *e* read?

7. Compare the angles *pom* and *pon* in size.

Angles of the size of these formed on the same side of a straight line so as to make the adjacent angles equal are **right angles.**

8. How many other right angles are shown above?

9. How many right angles in the same plane can have their vertices at the same point?

10. Compare the angles of *D* with right angles in size.

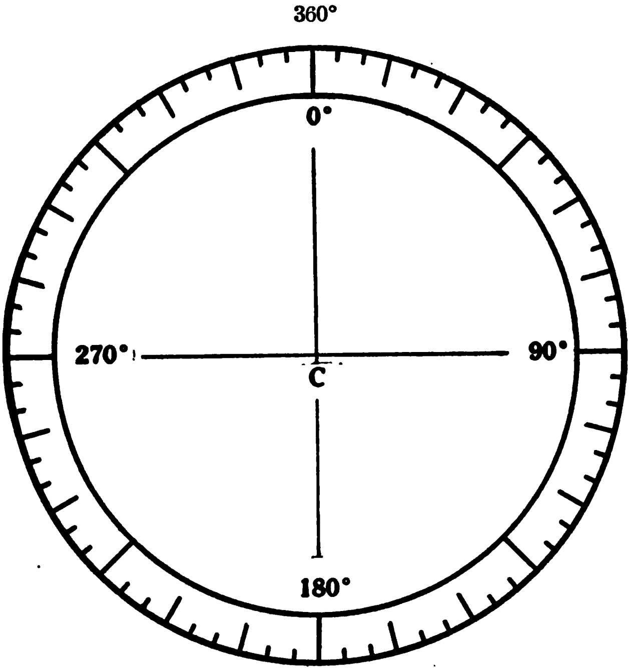
11. What other angles smaller than right angles are shown?

Such angles are **acute** (sharp) **angles.**

12. What angles larger than right angles are shown?

Such angles are **obtuse** (blunt) **angles.**

Measure



The whole difference in direction round any point, as *C*, is divided into 360 equal parts called *degrees*.

13. How many of these degrees in one right angle? In 2? In 3?

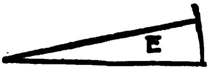
In writing numbers of degrees use the sign of degrees, thus: 17°, 45°.

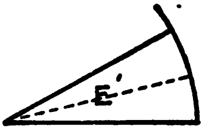
14. What do you know of the number of degrees in an acute angle? In an obtuse angle?

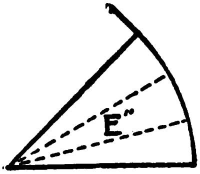
15. How many degrees in $\frac{1}{2}$ of a right angle? In $\frac{1}{3}$ of a right angle?

16. How many degrees in $\frac{2}{3}$ of a right angle? In $\frac{1}{6}$ of a right angle?

17. Over how many degrees does the minute-hand of a clock pass in 15 min.? In 5 min.?







18. Compare the angles *E*, *E′*, and *E″* in size.

A part of the circumference of a circle is an **arc.**

19. Where are the centers of the arcs which join the sides of these angles?

20. Compare the arcs for the angles *E*, *E′*, and *E″*.

21. How does the increase of the arcs compare with the increase of the angles?

An angle is measured by the number of degrees in the arc joining its sides and centering at the vertex.

22. How many degrees in half of a circumference?

23. How many of these degrees in one right angle?

24. What do you know of the number of degrees in an acute angle? Of the number in an obtuse angle?

25. How many degrees in $\frac{1}{2}$ of a right angle? In $\frac{1}{3}$ of a right angle? In $\frac{2}{3}$ of a right angle? In $\frac{1}{6}$?

26. Over how many degrees does the minute-hand of a clock pass in 15 min.? In 5 min.?

27. Over how many degrees does the hour-hand pass in 6 hours? In 3 hours? In 9 hours? In 2 hours? In 1 hour?

28. How many acute angles are there in *A*, page 153? How many obtuse angles in *D?*

29. The angle at *E* is about what part of a right angle?

30. The largest angle in *A* equals how many right angles?

31. Through how many degrees does the second-hand of a watch move in 10 seconds? In 25 seconds?

32. Through how many degrees does a point on the earth's surface move in the earth's rotation for 24 h.?

33. Through how many degrees does it move in 2 h.? In 1 h.?

34. What part of an hour, or how many minutes, does it take to move through 1°?

35. If one of two places is 15° farther east than the other, how much difference in their times of sunrise is there?

36. Which will have its sunrise earlier? How much?

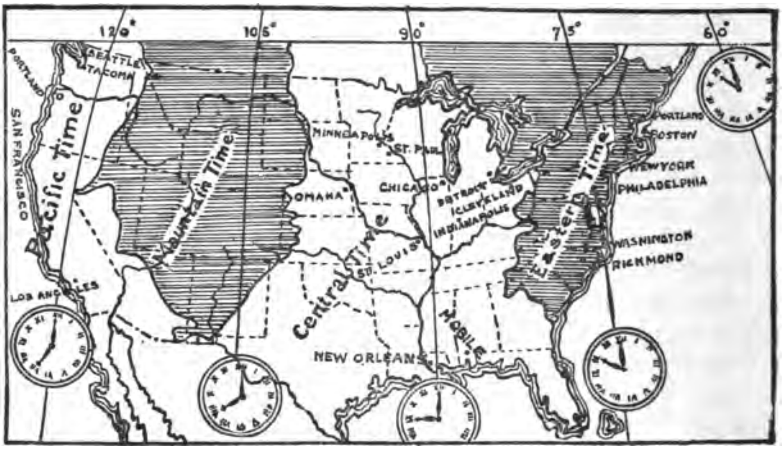
37. When it is 12 o'clock, sun time, at a certain point, what is the sun time 15° farther east? 1° farther east?

38. What is it 5° farther west? 60° farther west?

If a point is 15° east of another its sun time is 1 h. faster.

If it is 1° farther east its sun time is 4 min. faster.

39. If Paris is 75° east of New York, how does its sun time compare with that of New York?



The standard time system in the United States adopts the time of the 75th meridian for a belt extending with irregular boundaries on each side of that meridian, the time of the 90th meridian for a similar belt on each side of that meridian, the time of the 105th meridian for a belt on each side of that meridian, and the time of the 120th meridian for a belt on each side of that.

As shown by the map, the boundaries of these time belts are determined largely by the lines of travel and transportation.

40. How many degrees apart are these meridians? What is the difference in time in two adjacent belts?

41. A place on the 70th meridian has the time of what meridian?

What *is* its sun time when it is noon by the standard time?

42. New York City is 74° west longitude? When it is 6 A.M. by its standard time, what is its sun time?

43. Will the sun time of a place on the 71st meridian be faster or slower than its standard time? How much?

Use the best maps in your geography to aid you in answering the following questions.

Is the sun time faster, or slower, than the standard time, and approximately how much:

44. In Washington, D. C.? In Pittsburg?
45. In Charleston? In Savannah?
46. In Cleveland? In Chicago?
47. In New Orleans? In Galveston?
48. In Denver? In Salt Lake City?
49. In Seattle? In San Francisco?

50. When it is 9 A.M. at New York, what time is it at Detroit? At St. Louis? At Memphis? At Minneapolis?

51. At Omaha? At Portland, Ore.? At Los Angeles?

52. When it is 12 M. at Chicago, what time is it at Boston? At San Francisco? At Salt Lake City? At Los Angeles? At St. Louis?

53. When it is 12 M. at San Francisco, what time is it is Boston?

54. When it is 12 M. in Boston, what time is it in San Francisco?

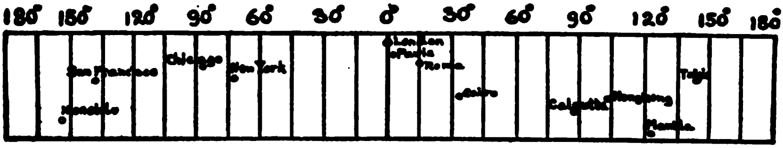
55. On ocean steamers going east or west the clocks are set every day to agree with the time of the longitude which they have reached.

On steamers going east, are they set forward, or backward?

On steamers going west?

Greenwich is on the meridian from which longitude is measured. Its longitude is 0°.

New York, 74° west
Chicago, 87½° west
San Francisco, 122½° west
Paris, Greenwich time
Rome, standard time of meridian, 15° east
Manila, time of meridian, 120° east
Tokyo, time of meridian, 135° east



WORLD BELT SHOWING LONGITUDE

In the following questions take the standard time for places where that has been given and sun time for other places:

56. When it is 12 M. in New York, what time is it in Chicago?

57. In San Francisco? In Rome?

58. In Greenwich? In Manila?

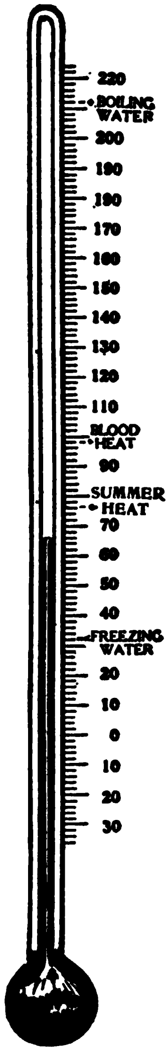
59. In Paris? In Tokyo?

60. It is 6 A.M. at Philadelphia. What time is it at Omaha?

61. If an ocean steamer goes 10° eastward in 24 hours, how much must the clock be changed to make it agree with the true time of the longitude which it has reached?

62. Should it be set forward, or backward?

63. If another steamer goes 12° westward in 24 hours, how much should its clock be changed? Forward, or backward?



Thermometers in common use in the United States have the Fahrenheit scale, and that is the one shown here.

1. Is the freezing point of water above or below 0? How many degrees?

Examine the scale. Each space represents how many degrees?

2. How many degrees above 0 is the boiling point of water?

3. How many degrees above the freezing point?

4. Blood heat is how many degrees above 0?

5. Blood heat is the temperature of the interior of the human body in health. The temperature of a fever patient went up to 103°. How much higher than the usual temperature was that?

6. On a certain night the outdoor temperature went down to 18° below 0.

How many degrees below freezing point was that?

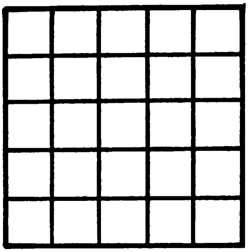
7. The average January temperature in the coldest part of Siberia is 60° below 0. In Manila it is 80° above 0. How great is the difference?

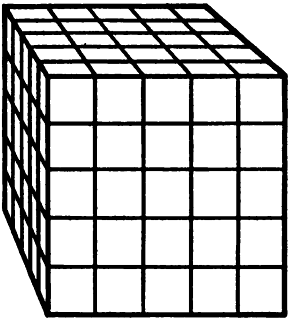
8. Is this difference greater or less than the difference between the freezing point and the boiling point of water? By how many degrees?

9. The temperature rose from 7° below 0 to 40° above. How much did it rise?

10. Blood heat is how many degrees above the freezing point of water?

11. How many below the boiling point of water?





1. $5 \times 5 = x$ $5 \times 5 \times 5 = x$

The numbers which multiplied together produce a number are the factors of that number.

2. How do the above factors compare?

A product of like factors is called a power.

One of the like factors of a number is called a root.

3. Of how many like factors is 25 the product?

A product of 2 like factors is the 2d power, or square.

4. What is the square of 9? Of 11?

One of the two like factors of a number is called the 2d root, or **square root,** of the number.

5. What is the square root of 64? Of 16? Of 144?

6. What is the square of 5? Of $5\frac{1}{2}$?

7. A product of 3 like factors is called the 3d power, or cube.

One of the 3 like factors is the 3d root, or cube root.

What is the cube of 4? Of 5?

8. What is the cube root of 64? Of 8? Of 27?

9. Other powers and roots are named from the number of like factors involved. What power of 2 is 16? 32?

10. What root is 2 of each of these numbers?

Optional

The square of 3 may be expressed 3^2. The cube of 4 may be expressed 4^3.

1. What fraction occurs in each root at the left? What fraction in each power?

2. Notice that the square of $1\frac{1}{2}$ equals $(2 \times 1) + \frac{1}{4}$, and that $(2\frac{1}{2})^2$ equals $(3 \times 2) + \frac{1}{4}$. What numbers multiplied together produce the whole number of the square of $3\frac{1}{2}$?

$(1\frac{1}{2})^2 = 2\frac{1}{4}$
$(2\frac{1}{2})^2 = 6\frac{1}{4}$
$(3\frac{1}{2})^2 = 12\frac{1}{4}$
$(4\frac{1}{2})^2 = 20\frac{1}{4}$
$(5\frac{1}{2})^2 = 30\frac{1}{4}$
$(6\frac{1}{2})^2 = 42\frac{1}{4}$
$(7\frac{1}{2})^2 = 56\frac{1}{4}$
$(8\frac{1}{2})^2 = 72\frac{1}{4}$
$(9\frac{1}{2})^2 = 90\frac{1}{4}$
$(10\frac{1}{2})^2 = 110\frac{1}{4}$
$(11\frac{1}{2})^2 = 132\frac{1}{4}$
$(12\frac{1}{2})^2 = 156\frac{1}{4}$

$15^2 = 225$
$25^2 = 625$
$35^2 = 1225$
$45^2 = 2025$
$55^2 = 3025$
$65^2 = 4225$
$75^2 = 5625$
$85^2 = 7225$
$95^2 = 9025$
$105^2 = 11025$
$115^2 = 13225$
$125^2 = 15625$

3. What numbers multiplied together produce the whole number of the square of $4\frac{1}{2}$?

4. What produce the whole number of the square of $5\frac{1}{2}$?

5. What the whole number of the square of $6\frac{1}{2}$?

6. Of $7\frac{1}{2}$? Of $8\frac{1}{2}$? Of $9\frac{1}{2}$? Of $10\frac{1}{2}$? Of $11\frac{1}{2}$? Of $12\frac{1}{2}$?

7. $\frac{1}{2} \times \frac{1}{2} = x$. What power of $\frac{1}{2}$ is $\frac{1}{4}$?

To find the square of a whole number and a half, multiply the whole number by the next larger number and add the square of the half.

8. $15 = x$ tens $25 = x$ tens $35 = x$ tens $65 = x$ tens $95 = x$ tens $125 = x$ tens

Think of 15, 25, 35, etc., as $1\frac{1}{2}$ tens, $2\frac{1}{2}$ tens, etc.

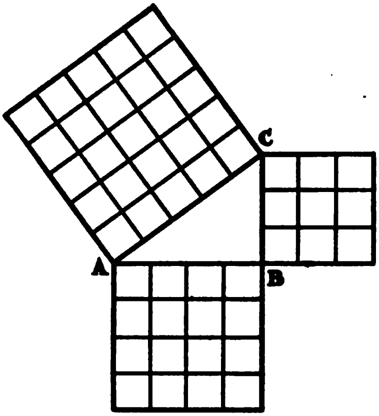
Note that **tens multiplied by tens produce hundreds.** So $\frac{1}{2}$ ten $\times$ $\frac{1}{2}$ ten $= \frac{1}{4}$ hundred.

a. $(1\frac{1}{2}\text{ tens})^2 = (2\text{ tens} \times \text{ten}) + (\frac{1}{2}\text{ ten})^2 = (20 \times 10) + 5^2 = 225$.

b. $(2\frac{1}{2}\text{ tens})^2 = (3\text{ tens} \times 2\text{ tens}) + (\frac{1}{2}\text{ ten})^2 = (30 \times 20) + 5^2 = 625$.

c. $(3\frac{1}{2}\text{ tens})^2 = (40 \times 30) + 25 = x$ $45^2 = (50 \times 40) + 25 = x$

d. $65^2 = (x \times x) + x = x$ $95^2 = (x \times x) + x = x$



1. In the triangle *ABC*, what kind of an angle is *B?*

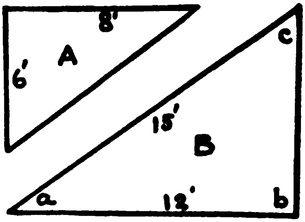
A triangle containing a right angle, is a **right-angled triangle.**

2. The side opposite the right angle, is called the **hypothenuse.**

How does the square of the hypothenuse compare with the sum of the squares of the other two sides?

The same is true of all right-angled triangles.

3. How can the square of the hypothenuse be found from the square of the other two sides?



4. The square of the hypothenuse of triangle *A* equals what?

5. How long is the hypothenuse?

6. If the squares of the hypothenuse and of another side are known, how can the square of the third side be found?

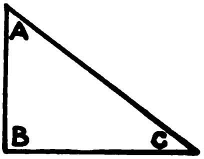
7. Find the square of *bc* in triangle *B.* How long is *bc?*

8. If the hypothenuse of a right-angled triangle is 50 rd. and another side 30 rd., how long is the third side?

9. If the hypothenuse is 25 ft. and another side is 15 ft., how long is the third side?

10. If the hypothenuse is 500.mi. and another side 300 mi., how long is the third side?

11. In *ABC*, how many quarter inches long is *BC*? *AB*? How long is the hypothenuse?



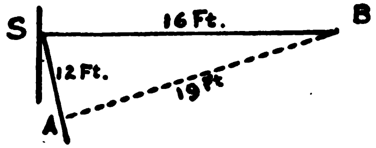
12. If *BC* were twice 4 units, and *AB* twice 3 units, how long would the hypothenuse be?

13. If *BC* were 3 times 4 units, and *AB* 3 times 3 units, how long would the hypothenuse be?

14. If *BC* were 4 times 4 units, and *AB* 4 times 3 units, how long would the hypothenuse be?

In a right-angled triangle, if one of the sides forming the right angle is a number of times 3 units long and another is the same number of times 4 units long, the hypothenuse is the same number of times 5 units long.

15. $AB = 15$ in., $BC = 20$ in., $AC = x$ in. $AB = 75$ ft., $BC = 100$ ft., $AC = x$ ft.

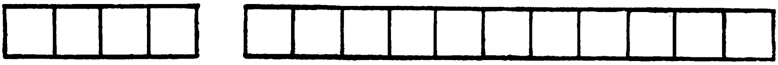


16. A line (cord) is stretched horizontally from the stake *S* to the right, as a guide for laying the foundation for the side of a house, and another is stretched from *S* toward you, as a guide for the foundation of an adjacent end. From *S* 12 ft. is measured off on one line ending at *A*, and 16 ft. on the other line ending at *B*. If the distance from *A* to *B* measures 19 ft., should it be increased or diminished to make the angle at *S* a right angle? How much?

17.* Find the 4th root of 625.

The 4th root equals the square root of the square root.

18.* What reason can you think of for naming the 2d power the square? For calling the second root the square root? What for the names cube and cube root?



A *B*

1. Compare B with A. $B = xA$

The quotient of one quantity divided by another of the same kind is often called the ratio of the one to the other.

2. What does the ratio of 15 yd. to 3 yd. equal? Of 2 qt. to 5 qt.? Of 7¢ to 2¢? Of 40 min. to 5 min.?

The division may be completed or expressed in fractional form.

It may also be expressed by the sign of division; and it has often been expressed by using the colon in place of the sign of division. Thus the ratio of 5° to 3° may be expressed 5° ÷ 3°, or 5° : 3°.

3. What does the ratio of 2 lb. to 8 oz. equal? Of 8 oz. to 2 lb.?

4. Of 4 yr. to 3 m.? Of 6 m. to 2 yr.? Of \$2 to 25¢?

5. What does the ratio of 15¢ to 25¢ equal? If a dozen bananas can be bought for 15¢, how many should be obtained for 25¢?

6. A motor boat was 20 ft. long, 4 ft. wide, and 20 in. deep. A boat on the same model 16 ft. long should be how wide? How deep?

7. A boat on the same model 24 ft. long should be how wide? How deep?

8. In cooking Quaker Oats, use $2\frac{1}{4}$ cups of water for 1 cup of oats. How much water should be used for $1\frac{1}{2}$ cups of oats? For $2\frac{1}{2}$ cups?

9.* To make apple snow for 8 persons, use 7 apples, cup of sugar, and 5 egg whites. How much of each ingredient should be used for 12 persons?

10. 1 gal. : 1 pt. $= x$ 1 T : 500 $= x$

11. To make divinity fudge, use 3 cups of sugar, 1 cup of Karo corn, $\frac{1}{2}$ cup of water, the whites of 2 eggs, 1 cup of chopped nuts, and a teaspoonful of vanila. How much of each ingredient should be used to make $1\frac{1}{2}$ times this quantity?

12. A building is 42 ft. by 60 ft., with walls 24 ft. high, and roof 12 ft. high projecting 4 ft. beyond the walls. Give the corresponding dimensions for a building 28 ft. wide having the same proportions.

13. For 2 qt. of ice-cream use $1\frac{1}{2}$ pt. of cream, $1\frac{1}{2}$ pt. of milk, 1 cup of sugar, the juice from 1 box of raspberries, and a few drops of extract of lemon. How much of each ingredient is required for 3 qt. of cream?

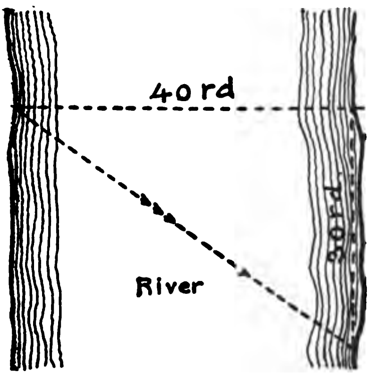
14. A cylindrical silo is 21 ft. in diameter and 30 ft. deep. How deep will one of the same shape 14 ft. in diameter be?

15. What is the ratio of the volume of a cylinder to that of a cone of the same base and altitude?

16. What is the ratio of the convex surface of a cone to that of a cylinder of the same diameter with an altitude equal to the slant height of the cone?

17. What is the ratio of the surface of a sphere to the convex surface of a cylinder of the same diameter with an altitude equal to the diameter?

18. In going across a river 40 rd. wide, a boat was carried 30 rd. down-stream by the current. How many rods did it actually move?

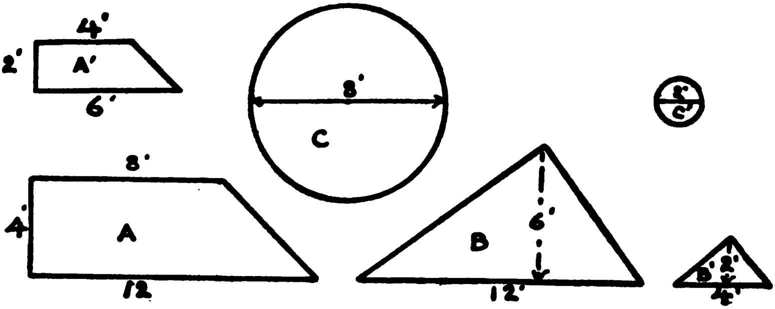


1 lb. : 4 oz. $= x$

19. 1 gal. : 1 qt. $= x$ 3 in. : 1 ft. $= x$

20. 1 mi. : 40 rd. $= x$ 40 rd. : 1 m. $= x$

Areas of Similar Surfaces



21. How do *A* and *A′* compare in shape?

22. What does the ratio of the altitude of *A* to that of *A′* equal?

23. What does the ratio between the upper parallel sides equal?

24. The ratio between the lower parallel sides?

25. What does the ratio of the area of *A* to that of *A′* equal? What power of 2 is 4?

26. How do *B* and *B′* compare in shape?

27. The ratio of the altitude of *B* to that of *B′* equals what?

28. What does the ratio of the base of *B* to that of *B′* equal?

29. What does the ratio of the area of *B* to that of *B′* equal? What power of 3 is 9?

30. How do *C* and *C′* compare in shape?

31. What does the ratio of the diameter of *C* to that of *C′* equal?

32. What does the ratio of the circumference of *C* to that of *C′* equal?

33. What does the ratio of the area of *C* to that of *C′* equal? What power of 4 is 16?

The area of any surface equals the area of a similar surface multiplied by the square of the ratio of any line of the first to the corresponding line of the second.

34. The ratio of the radius of one circle to that of another equals 10. The square of 10 equals what? The area of the first equals how many times that of the second?

35. A quarter circle contains 8 sq. ft. How many square feet will a quarter circle whose radius is 10 times as great, contain?

36. A quarter circle of half this radius has what area?

37. Radius A ÷ Radius $A' = \frac{1}{2}$ Area A ÷ Area $A' = x$

38. 1 sq. ft. : 1 sq. yd. $= x$ 1 sq. yd. : 1 sq. ft. $= x$

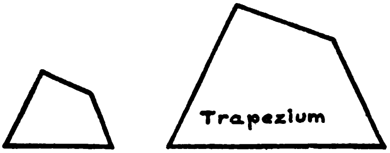
39. 1 cu. ft. : 1 cu. yd. $= x$ 1 cu. yd. : 1 cu. yd. $= x$

40. The ratio of the width of a parallelogram to that of a similar parallelogram equals ½. The square of this ratio equals what? The area of the first is what part of that of the second?

41. A side of a square field equals ¼ of the side of another square field. Its area is what part as great?

42. A side of a floor equals ⅓ of the corresponding side of a similar floor. Its area is what part as great?

43. A side of a trapezium equals ½ of the corresponding side of a similar trapezium. Its area equals what part of that of a similar trapezium?

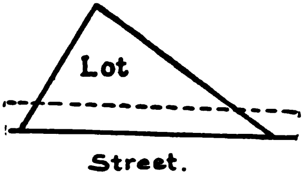


44. A sail 8 ft. high contains 20 sq. yd. of cloth. One of the same shape 16 ft. high contains how many square yards? One 24 ft. high contains how many square yards?

45. The outside surface of a boat 20 ft. long contains 160 sq. ft. What is the area of the outside surface of a boat of the same shape 60 ft. long?

46. It costs \$5 to paint a boat 16 ft. long. What will it cost to paint one of the same shape 48 ft. long?

47. A circular bed 6 ft. in diameter has a flower border 1 ft. wide. The center is turfed. What part of the bed is turfed? What part is set with flowers?

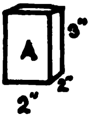


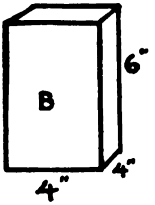
48. In widening a street to a line parallel with the original street line a triangular lot containing 8000 sq. ft. had its street line reduced to $\frac{3}{4}$ of its original length. What part of its area remained?

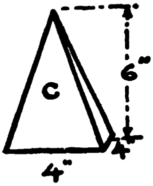
49. What part was taken for the street? How many feet?

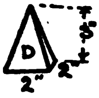
50. At 10¢ a square foot, how much would the owner receive from the city?

Volumes of Similar Solids









51. How do the prisms *A* and *B* compare in shape?

52. The ratio of the width of *B* to that of *A* equals what?

53. The ratio of the altitude of *B* to *A* equals what?

54. The ratio of the volume of *B* to that of *A* equals what? What power of 2 is 8?

55. How do the pyramids *C* and *D* compare in shape?

56. The ratio of a side of the base of *D* to a side of the base of *C* equals what?

57. The ratio of the altitude of *D* to that of *C* equals what?

58. The ratio of the volume of *D* to that of *C* equals what? What power of $\frac{1}{2}$ is $\frac{1}{8}$?

The volume of any solid equals the volume of a similar solid multiplied by the cube of the ratio of any line of the first to the corresponding line of the second.

59. The diameter of a sphere equals twice the diameter of another sphere. The volume of the first compares how with that of the second?

60. The height of a cone is 3 times that of a similar cone. The volume of the first compares how with that of the second?

61. The volume of a cone 15 in. high is 270 cu. in. What is the volume of a similar cone 5 in. high?

62. Of one 10 in. high?

63. A cylindrical pail 4 in. in diameter will hold 150 cu. in. of water. How much will a pail of similar shape 8 in. in diameter hold?

64. How much will one of a similar shape 12 in. in diameter hold?

65. Find the volume of a cylinder 2 ft. in diameter and 2 ft. high.

66. Of a similar one 4 ft. in diameter.

Find this in the easiest way.

67.* Of a cone 2 in. in diameter and 2 in. high.

68.* Of a similar cone 4 in. in diameter.

69.* Of a similar cone 8 in. in diameter.

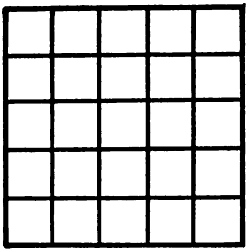
70.* Of a sphere 2 in. in diameter.

71.* Of a sphere 4 in. in diameter.

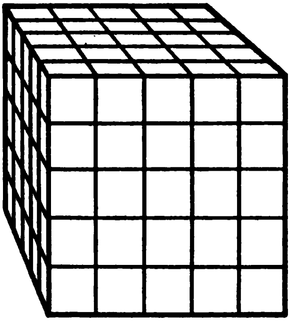
72.* Of a sphere 8 in. in diameter.

73.* Of a sphere 1 in. in diameter.

74.* Of a cone 1 in. in diameter and 1 in. high.



1. $5 \times 5 = x$



$5 \times 5 \times 5 = x$

The numbers which multiplied together produce a number are the factors of that number.

2. How do the above factors compare?

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One of the like factors of a number is called a root.

3. Of how many like factors is 25 the product?

A product of 2 like factors is the 2d power, or square.

4. What is the square of 9? Of 11?

One of the two like factors of a number is called the 2d root, or **square root,** of the number.

5. What is the square root of 64? Of 16? Of 144?

6. What is the square of 5? Of $5\frac{1}{2}$?

7. **A product of 3 like factors is called the 3d power, or cube.**

One of the 3 like factors is the 3d root, or cube root.

What is the cube of 4? Of 5?

8. What is the cube root of 64? Of 8? Of 27?

9. Other powers and roots are named from the number of like factors involved. What power of 2 is 16? 32?

10. What root is 2 of each of these numbers?

Optional

The square of 3 may be expressed 3^2. The cube of 4 may be expressed 4^3.

1. What fraction occurs in each root at the left? What fraction in each power?

2. Notice that the square of $1\frac{1}{2}$ equals $(2 \times 1) + \frac{1}{4}$, and that $(2\frac{1}{2})^2$ equals $(3 \times 2) + \frac{1}{4}$. What numbers multiplied together produce the whole number of the square of $3\frac{1}{2}$?

$(1\frac{1}{2})^2 = 2\frac{1}{4}$ $15^2 = 225$
$(2\frac{1}{2})^2 = 6\frac{1}{4}$ $25^2 = 625$
$(3\frac{1}{2})^2 = 12\frac{1}{4}$ $35^2 = 1225$
$(4\frac{1}{2})^2 = 20\frac{1}{4}$ $45^2 = 2025$
$(5\frac{1}{2})^2 = 30\frac{1}{4}$ $55^2 = 3025$
$(6\frac{1}{2})^2 = 42\frac{1}{4}$ $65^2 = 4225$
$(7\frac{1}{2})^2 = 56\frac{1}{4}$ $75^2 = 5625$
$(8\frac{1}{2})^2 = 72\frac{1}{4}$ $85^2 = 7225$
$(9\frac{1}{2})^2 = 90\frac{1}{4}$ $95^2 = 9025$
$(10\frac{1}{2})^2 = 110\frac{1}{4}$ $105^2 = 11025$
$(11\frac{1}{2})^2 = 132\frac{1}{4}$ $115^2 = 13225$
$(12\frac{1}{2})^2 = 156\frac{1}{4}$ $125^2 = 15625$

3. What numbers multiplied together produce the whole number of the square of $4\frac{1}{2}$?

4. What produce the whole number of the square of $5\frac{1}{2}$?

5. What the whole number of the square of $6\frac{1}{2}$?

6. Of $7\frac{1}{2}$? Of $8\frac{1}{2}$? Of $9\frac{1}{2}$? Of $10\frac{1}{2}$? Of $11\frac{1}{2}$? Of $12\frac{1}{2}$?

7. $\frac{1}{2} \times \frac{1}{2} = x$. What power of $\frac{1}{2}$ is $\frac{1}{4}$?

To find the square of a whole number and a half, multiply the whole number by the next larger number and add the square of the half.

8. $15 = x$ tens $25 = x$ tens $35 = x$ tens $65 = x$ tens $95 = x$ tens $125 = x$ tens

Think of 15, 25, 35, etc., as $1\frac{1}{2}$ tens, $2\frac{1}{2}$ tens, etc.

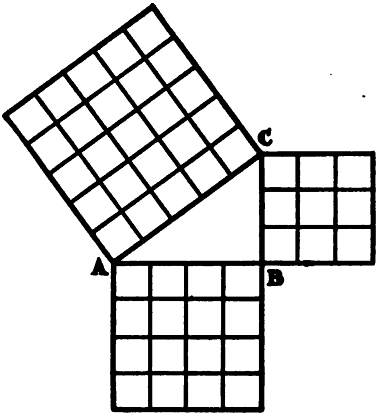
Note that **tens multiplied by tens produce hundreds.** So $\frac{1}{2}$ ten × $\frac{1}{2}$ ten = $\frac{1}{4}$ hundred.

a. $(1\frac{1}{2}\text{ tens})^2 = (2\text{ tens} \times \text{ten}) + (\frac{1}{2}\text{ ten})^2 = (20 \times 10) + 5^2 = 225$.

b. $(2\frac{1}{2}\text{ tens})^2 = (3\text{ tens} \times 2\text{ tens}) + (\frac{1}{2}\text{ ten})^2 = (30 \times 20) + 5^2 = 625$.

c. $(3\frac{1}{2}\text{ tens})^2 = (40 \times 30) + 25 = x$ $45^2 = (50 \times 40) + 25 = x$

d. $65^2 = (x \times x) + x = x$ $95^2 = (x \times x) + x = x$



1. In the triangle ABC, what kind of an angle is B?

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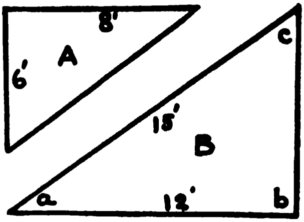
2. The side opposite the right angle, is called the **hypothenuse.**

How does the square of the hypothenuse compare with the sum of the squares of the other two sides?

The same is true of all right-angled triangles.

3. How can the square of the hypothenuse be found from the square of the other two sides?



4. The square of the hypothenuse of triangle A equals what?

5. How long is the hypothenuse?

6. If the squares of the hypothenuse and of another side are known, how can the square of the third side be found?

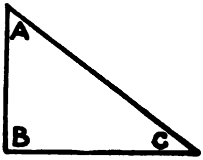
7. Find the square of bc in triangle B. How long is bc?

8. If the hypothenuse of a right-angled triangle is 50 rd. and another side 30 rd., how long is the third side?

9. If the hypothenuse is 25 ft. and another side is 15 ft., how long is the third side?

10. If the hypothenuse is 500 mi. and another side 300 mi., how long is the third side?

11. In *ABC*, how many quarter inches long is *BC*? *AB*? How long is the hypothenuse?



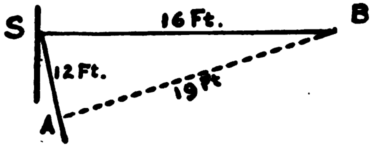
12. If *BC* were twice 4 units, and *AB* twice 3 units, how long would the hypothenuse be?

13. If *BC* were 3 times 4 units, and *AB* 3 times 3 units, how long would the hypothenuse be?

14. If *BC* were 4 times 4 units, and *AB* 4 times 3 units, how long would the hypothenuse be?

In a right-angled triangle, if one of the sides forming the right angle is a number of times 3 units long and another is the same number of times 4 units long, the hypothenuse is the same number of times 5 units long.

15. $AB = 15$ in., $BC = 20$ in., $AC = x$ in. $AB = 75$ ft., $BC = 100$ ft., $AC = x$ ft.

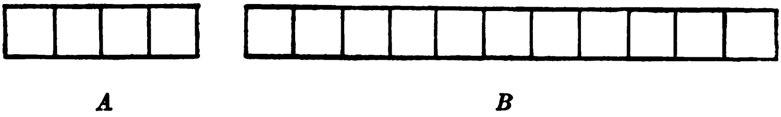


16. A line (cord) is stretched horizontally from the stake *S* to the right, as a guide for laying the foundation for the side of a house, and another is stretched from *S* toward you, as a guide for the foundation of an adjacent end. From *S* 12 ft. is measured off on one line ending at *A*, and 16 ft. on the other line ending at *B*. If the distance from *A* to *B* measures 19 ft., should it be increased or diminished to make the angle at *S* a right angle? How much?

17.* Find the 4th root of 625.

The 4th root equals the square root of the square root.

18.* What reason can you think of for naming the 2d power the square? For calling the second root the square root? What for the names cube and cube root?



1. Compare B with A. $B = xA$

The quotient of one quantity divided by another of the same kind is often called the ratio of the one to the other.

2. What does the ratio of 15 yd. to 3 yd. equal? Of 2 qt. to 5 qt.? Of 7¢ to 2¢? Of 40 min. to 5 min.?

The division may be completed or expressed in fractional form.

It may also be expressed by the sign of division; and it has often been expressed by using the colon in place of the sign of division. Thus the ratio of 5° to 3° may be expressed $5^\circ \div 3^\circ$, or $5^\circ : 3^\circ$.

3. What does the ratio of 2 lb. to 8 oz. equal? Of 8 oz. to 2 lb.?

4. Of 4 yr. to 3 m.? Of 6 m. to 2 yr.? Of $2 to 25¢?

5. What does the ratio of 15¢ to 25¢ equal? If a dozen bananas can be bought for 15¢, how many should be obtained for 25¢?

6. A motor boat was 20 ft. long, 4 ft. wide, and 20 in. deep. A boat on the same model 16 ft. long should be how wide? How deep?

7. A boat on the same model 24 ft. long should be how wide? How deep?

8. In cooking Quaker Oats, use $2\frac{1}{4}$ cups of water for 1 cup of oats. How much water should be used for $1\frac{1}{2}$ cups of oats? For $2\frac{1}{2}$ cups?

9.* To make apple snow for 8 persons, use 7 apples, cup of sugar, and 5 egg whites. How much of each ingredient should be used for 12 persons?

10. 1 gal. : 1 pt. = x 1 T : 500 = x

11. To make divinity fudge, use 3 cups of sugar, 1 cup of Karo corn, ½ cup of water, the whites of 2 eggs, 1 cup of chopped nuts, and a teaspoonful of vanila. How much of each ingredient should be used to make 1½ times this quantity?

12. A building is 42 ft. by 60 ft., with walls 24 ft. high, and roof 12 ft. high projecting 4 ft. beyond the walls. Give the corresponding dimensions for a building 28 ft. wide having the same proportions.

13. For 2 qt. of ice-cream use 1½ pt. of cream, 1½ pt. of milk, 1 cup of sugar, the juice from 1 box of raspberries, and a few drops of extract of lemon. How much of each ingredient is required for 3 qt. of cream?

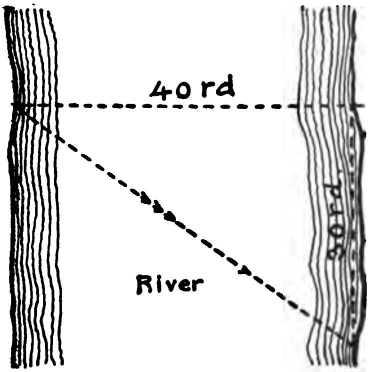
14. A cylindrical silo is 21 ft. in diameter and 30 ft. deep. How deep will one of the same shape 14 ft. in diameter be?

15. What is the ratio of the volume of a cylinder to that of a cone of the same base and altitude?

16. What is the ratio of the convex surface of a cone to that of a cylinder of the same diameter with an altitude equal to the slant height of the cone?

17. What is the ratio of the surface of a sphere to the convex surface of a cylinder of the same diameter with an altitude equal to the diameter?

18. In going across a river 40 rd. wide, a boat was carried 30 rd. down-stream by the current. How many rods did it actually move?

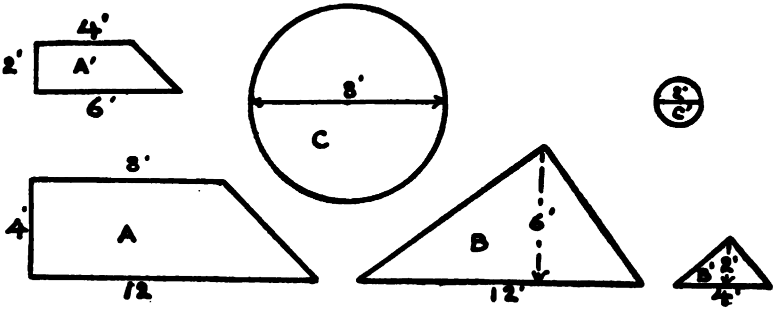


1 lb. : 4 oz. $= x$

19. 1 gal. : 1 qt. $= x$ 3 in. : 1 ft. $= x$

20. 1 mi. : 40 rd. $= x$ 40 rd. : 1 m. $= x$

Areas of Similar Surfaces



21. How do A and A' compare in shape?

22. What does the ratio of the altitude of A to that of A' equal?

23. What does the ratio between the upper parallel sides equal?

24. The ratio between the lower parallel sides?

25. What does the ratio of the area of A to that of A' equal? What power of 2 is 4?

26. How do B and B' compare in shape?

27. The ratio of the altitude of B to that of B' equals what?

28. What does the ratio of the base of B to that of B' equal?

29. What does the ratio of the area of B to that of B' equal? What power of 3 is 9?

30. How do C and C' compare in shape?

31. What does the ratio of the diameter of C to that of C' equal?

32. What does the ratio of the circumference of C to that of C' equal?

33. What does the ratio of the area of C to that of C' equal? What power of 4 is 16?

The area of any surface equals the area of a similar surface multiplied by the square of the ratio of any line of the first to the corresponding line of the second.

34. The ratio of the radius of one circle to that of another equals 10. The square of 10 equals what? The area of the first equals how many times that of the second?

35. A quarter circle contains 8 sq. ft. How many square feet will a quarter circle whose radius is 10 times as great, contain?

36. A quarter circle of half this radius has what area?

37. Radius A ÷ Radius $A' = \frac{1}{2}$ Area A ÷ Area $A' = x$

38. 1 sq. ft. : 1 sq. yd. $= x$ 1 sq. yd. : 1 sq. ft. $= x$

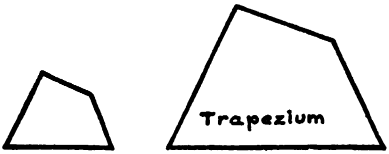
39. 1 cu. ft. : 1 cu. yd. $= x$ 1 cu. yd. : 1 cu. yd. $= x$

40. The ratio of the width of a parallelogram to that of a similar parallelogram equals $\frac{1}{2}$. The square of this ratio equals what? The area of the first is what part of that of the second?

41. A side of a square field equals $\frac{1}{4}$ of the side of another square field. Its area is what part as great?

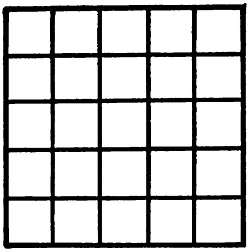
42. A side of a floor equals $\frac{1}{3}$ of the corresponding side of a similar floor. Its area is what part as great?

43. A side of a trapezium equals $\frac{1}{2}$ of the corresponding side of a similar trapezium. Its area equals what part of that of a similar trapezium?

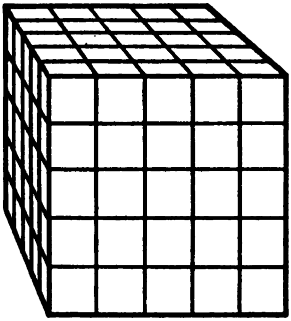


44. A sail 8 ft. high contains 20 sq. yd. of cloth. One of the same shape 16 ft. high contains how many square yards? One 24 ft. high contains how many square yards?

45. The outside surface of a boat 20 ft. long contains 160 sq. ft. What is the area of the outside surface of a boat of the same shape 60 ft. long?



1. $5 \times 5 = x$



$5 \times 5 \times 5 = x$

The numbers which multiplied together produce a number are the factors of that number.

2. How do the above factors compare?

A product of like factors is called a power.

One of the like factors of a number is called a root.

3. Of how many like factors is 25 the product?

A product of 2 like factors is the 2d power, or square.

4. What is the square of 9? Of 11?

One of the two like factors of a number is called the 2d root, or **square root,** of the number.

5. What is the square root of 64? Of 16? Of 144?

6. What is the square of 5? Of $5\frac{1}{2}$?

7. **A product of 3 like factors is called the 3d power, or cube.**

One of the 3 like factors is the 3d root, or cube root.

What is the cube of 4? Of 5?

8. What is the cube root of 64? Of 8? Of 27?

9. Other powers and roots are named from the number of like factors involved. What power of 2 is 16? 32?

10. What root is 2 of each of these numbers?

Optional

The square of 3 may be expressed 3^2. The cube of 4 may be expressed 4^3.

1. What fraction occurs in each root at the left? What fraction in each power?

2. Notice that the square of $1\frac{1}{2}$ equals $(2 \times 1) + \frac{1}{4}$, and that $(2\frac{1}{2})^2$ equals $(3 \times 2) + \frac{1}{4}$. What numbers multiplied together produce the whole number of the square of $3\frac{1}{2}$?

$(1\frac{1}{2})^2 = 2\frac{1}{4}$	$15^2 = 225$
$(2\frac{1}{2})^2 = 6\frac{1}{4}$	$25^2 = 625$
$(3\frac{1}{2})^2 = 12\frac{1}{4}$	$35^2 = 1225$
$(4\frac{1}{2})^2 = 20\frac{1}{4}$	$45^2 = 2025$
$(5\frac{1}{2})^2 = 30\frac{1}{4}$	$55^2 = 3025$
$(6\frac{1}{2})^2 = 42\frac{1}{4}$	$65^2 = 4225$
$(7\frac{1}{2})^2 = 56\frac{1}{4}$	$75^2 = 5625$
$(8\frac{1}{2})^2 = 72\frac{1}{4}$	$85^2 = 7225$
$(9\frac{1}{2})^2 = 90\frac{1}{4}$	$95^2 = 9025$
$(10\frac{1}{2})^2 = 110\frac{1}{4}$	$105^2 = 11025$
$(11\frac{1}{2})^2 = 132\frac{1}{4}$	$115^2 = 13225$
$(12\frac{1}{2})^2 = 156\frac{1}{4}$	$125^2 = 15625$

3. What numbers multiplied together produce the whole number of the square of $4\frac{1}{2}$?

4. What produce the whole number of the square of $5\frac{1}{2}$?

5. What the whole number of the square of $6\frac{1}{2}$?

6. Of $7\frac{1}{2}$? Of $8\frac{1}{2}$? Of $9\frac{1}{2}$? Of $10\frac{1}{2}$? Of $11\frac{1}{2}$? Of $12\frac{1}{2}$?

7. $\frac{1}{2} \times \frac{1}{2} = x$. What power of $\frac{1}{2}$ is $\frac{1}{4}$?

To find the square of a whole number and a half, multiply the whole number by the next larger number and add the square of the half.

8. $15 = x$ tens $25 = x$ tens $35 = x$ tens $65 = x$ tens $95 = x$ tens $125 = x$ tens

Think of 15, 25, 35, etc., as $1\frac{1}{2}$ tens, $2\frac{1}{2}$ tens, etc.

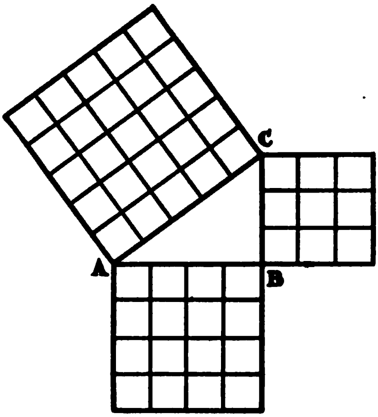
Note that **tens multiplied by tens produce hundreds.** So $\frac{1}{2}$ ten $\times$ $\frac{1}{2}$ ten $= \frac{1}{4}$ hundred.

a. $(1\frac{1}{2}\text{ tens})^2 = (2\text{ tens} \times \text{ten}) + (\frac{1}{2}\text{ ten})^2 = (20 \times 10) + 5^2 = 225$.

b. $(2\frac{1}{2}\text{ tens})^2 = (3\text{ tens} \times 2\text{ tens}) + (\frac{1}{2}\text{ ten})^2 = (30 \times 20) + 5^2 = 625$.

c. $(3\frac{1}{2}\text{ tens})^2 = (40 \times 30) + 25 = x$ $45^2 = (50 \times 40) + 25 = x$

d. $65^2 = (x \times x) + x = x$ $95^2 = (x \times x) + x = x$



1. In the triangle *ABC*, what kind of an angle is *B?*

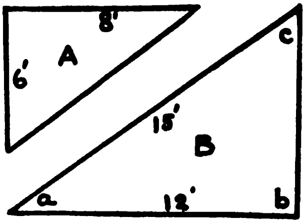
A triangle containing a right angle, is a **right-angled triangle.**

2. The side opposite the right angle, is called the **hypothenuse.**

How does the square of the hypothenuse compare with the sum of the squares of the other two sides?

The same is true of all right-angled triangles.

3. How can the square of the hypothenuse be found from the square of the other two sides?



4. The square of the hypothenuse of triangle *A* equals what?

5. How long is the hypothenuse?

6. If the squares of the hypothenuse and of another side are known, how can the square of the third side be found?

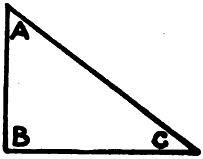
7. Find the square of *bc* in triangle *B*. How long is *bc?*

8. If the hypothenuse of a right-angled triangle is 50 rd. and another side 30 rd., how long is the third side?

9. If the hypothenuse is 25 ft. and another side is 15 ft., how long is the third side?

10. If the hypothenuse is 500 mi. and another side 300 mi., how long is the third side?

11. In *ABC*, how many quarter inches long is *BC*? *AB*? How long is the hypothenuse?



12. If *BC* were twice 4 units, and *AB* twice 3 units, how long would the hypothenuse be?

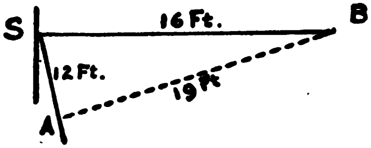
13. If *BC* were 3 times 4 units, and *AB* 3 times 3 units, how long would the hypothenuse be?

14. If *BC* were 4 times 4 units, and *AB* 4 times 3 units, how long would the hypothenuse be?

In a right-angled triangle, if one of the sides forming the right angle is a number of times 3 units long and another is the same number of times 4 units long, the hypothenuse is the same number of times 5 units long.

15. $AB = 15$ in., $BC = 20$ in., $AC = x$ in. $AB = 75$ ft., $BC = 100$ ft., $AC = x$ ft.

16. A line (cord) is stretched horizontally from the stake *S* to the right, as a guide for laying the foundation for the side of a house, and another is stretched from *S* toward you, as a guide for the foundation of an adjacent end. From *S* 12 ft. is measured off on one line ending at *A*, and 16 ft. on the other line ending at *B*. If the distance from *A* to *B* measures 19 ft., should it be increased or diminished to make the angle at *S* a right angle? How much?



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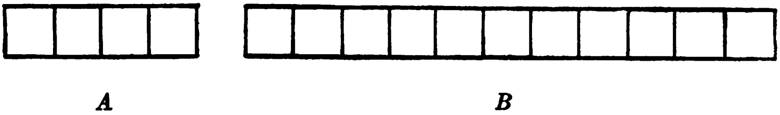
18.* What reason can you think of for naming the 2d power the square? For calling the second root the square root? What for the names cube and cube root?



1. Compare B with A. $B = xA$

The quotient of one quantity divided by another of the same kind is often called the ratio of the one to the other.

2. What does the ratio of 15 yd. to 3 yd. equal? Of 2 qt. to 5 qt.? Of 7¢ to 2¢? Of 40 min. to 5 min.?

The division may be completed or expressed in fractional form.

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3. What does the ratio of 2 lb. to 8 oz. equal? Of 8 oz. to 2 lb.?

4. Of 4 yr. to 3 m.? Of 6 m. to 2 yr.? Of $2 to 25¢?

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8. In cooking Quaker Oats, use $2\frac{1}{4}$ cups of water for 1 cup of oats. How much water should be used for $1\frac{1}{2}$ cups of oats? For $2\frac{1}{2}$ cups?

9.* To make apple snow for 8 persons, use 7 apples, cup of sugar, and 5 egg whites. How much of each ingredient should be used for 12 persons?

10. 1 gal. : 1 pt. $= x$ 1 T : 500 $= x$

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12. A building is 42 ft. by 60 ft., with walls 24 ft. high, and roof 12 ft. high projecting 4 ft. beyond the walls. Give the corresponding dimensions for a building 28 ft. wide having the same proportions.

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15. What is the ratio of the volume of a cylinder to that of a cone of the same base and altitude?

16. What is the ratio of the convex surface of a cone to that of a cylinder of the same diameter with an altitude equal to the slant height of the cone?

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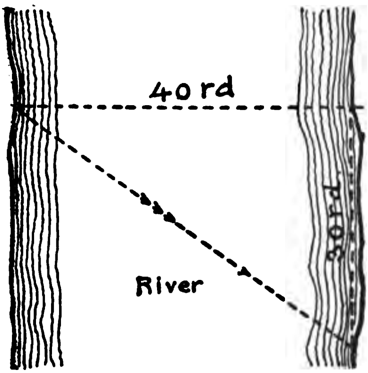
18. In going across a river 40 rd. wide, a boat was carried 30 rd. down-stream by the current. How many rods did it actually move?

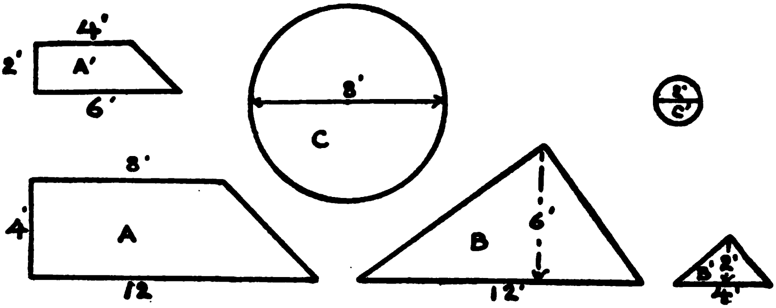


1 lb. : 4 oz. $= x$

19. 1 gal. : 1 qt. $= x$ 3 in. : 1 ft. $= x$

20. 1 mi. : 40 rd. $= x$ 40 rd. : 1 m. $= x$

Areas of Similar Surfaces



21. How do A and A' compare in shape?

22. What does the ratio of the altitude of A to that of A' equal?

23. What does the ratio between the upper parallel sides equal?

24. The ratio between the lower parallel sides?

25. What does the ratio of the area of A to that of A' equal? What power of 2 is 4?

26. How do B and B' compare in shape?

27. The ratio of the altitude of B to that of B' equals what?

28. What does the ratio of the base of B to that of B' equal?

29. What does the ratio of the area of B to that of B' equal? What power of 3 is 9?

30. How do C and C' compare in shape?

31. What does the ratio of the diameter of C to that of C' equal?

32. What does the ratio of the circumference of C to that of C' equal?

33. What does the ratio of the area of C to that of C' equal? What power of 4 is 16?

The area of any surface equals the area of a similar surface multiplied by the square of the ratio of any line of the first to the corresponding line of the second.

34. The ratio of the radius of one circle to that of another equals 10. The square of 10 equals what? The area of the first equals how many times that of the second?

35. A quarter circle contains 8 sq. ft. How many square feet will a quarter circle whose radius is 10 times as great, contain?

36. A quarter circle of half this radius has what area?

37. Radius A ÷ Radius $A' = \frac{1}{2}$ Area A ÷ Area $A' = x$

38. 1 sq. ft. : 1 sq. yd. $= x$ 1 sq. yd. : 1 sq. ft. $= x$

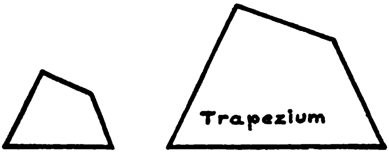
39. 1 cu. ft. : 1 cu. yd. $= x$ 1 cu. yd. : 1 cu. yd. $= x$

40. The ratio of the width of a parallelogram to that of a similar parallelogram equals ½. The square of this ratio equals what? The area of the first is what part of that of the second?

41. A side of a square field equals ¼ of the side of another square field. Its area is what part as great?

42. A side of a floor equals ⅓ of the corresponding side of a similar floor. Its area is what part as great?

43. A side of a trapezium equals ½ of the corresponding side of a similar trapezium. Its area equals what part of that of a similar trapezium?



44. A sail 8 ft. high contains 20 sq. yd. of cloth. One of the same shape 16 ft. high contains how many square yards? One 24 ft. high contains how many square yards?

45. The outside surface of a boat 20 ft. long contains 160 sq. ft. What is the area of the outside surface of a boat of the same shape 60 ft. long?

307. How many hours in $66\frac{2}{3}\%$ of a day?

308. Find the cost of 5 lb. 4 oz. of chicken @ 30¢.

309. How much is the postage on a package of clothing weighing 1 lb. 14 oz. sent 200 miles?

310. Find the interest of $800 @ 4% for 3 m. For 1 yr.

311. How much will it cost to insure a building for $1000 @ $\frac{3}{4}\%$?

312. On a scale of $\frac{1}{8}$ in. to 1 rd. how long a line will represent 40 rd.?

313. A north line and a northeast line from the same point form an angle of how many degrees?

314. Find the cost of 10 arithmetics @ 30¢ less 20%. Of 20 histories @ 40¢ less 20%.

315. How many board feet in a scantling (joist) 2 in. by 4 in. by 18 ft.?

316. Write decimally, in position to add, $71\frac{42}{100}$, $175\frac{9}{1000}$, $986\frac{4}{5}$, and $9\frac{5}{10}$.

317. Find the interest on $1000 for 6 m. @ 6%.

318. At $16 per ton how much will 1000 lb. of hay cost? 100 lb.?

319. How much is the premium for insuring a house for $1500 and furniture, musical instruments, books, clothing, etc., for $500 for 3 years @ 1%?

320. How much would it cost you to send by mail a package of newspapers weighing 10 oz.?

321. How much is the postage on a special delivery 1-pound 5-ounce package of merchandise sent 700 miles?

322. $3\frac{1}{2}$ yd. $\div$ $\frac{1}{3}$ yd. $= x$

323. A plumber worked from 9.40 to 10.10 @ 50¢ per hour. How much should he receive?

324. Write decimally in position to add $\frac{1}{4}$, $\frac{3}{5}$, $\frac{1}{8}$, $23\frac{7}{100}$, $3\frac{65}{1000}$, and $294\frac{47}{100}$.

325. Find the cost of a board 8 in. wide, 6 ft. long, and $\frac{3}{4}$ in. thick @ 8¢ a foot.

Find the interest at 6 *per cent in* 326-329:

326. On $300 for 6 d. For 1 d. For 5 d. For 12 d.

327. For 60 d. For 30 d. For 15 d. For 10 d.

328. For 20 m. For 10 m. For 30 m. For 40 m.

329. On $2000 for 20 m. For 2 m. For 4 m. For 6 m.

330. How many cubic feet of air space in a room 20 ft. by 30 ft. by 9 ft.?

331. Write as fractions $37\frac{1}{2}\%$, 20%, $16\frac{2}{3}\%$, $83\frac{1}{3}\%$, $87\frac{1}{2}\%$.

332. $\frac{1}{4} - \frac{1}{5} = x$ $\frac{3}{4} + \frac{1}{5} = x$

333. $\frac{3}{4} \div \frac{1}{5} = x$ $\frac{1}{5}$ of $\frac{3}{4} = x$

334. Find the cost of insuring a building for $2400 @ $\frac{3}{8}\%$.

335. Find the cost of 48 histories @ $1.20 less $16\frac{2}{3}\%$.

336. How much should be received for 1 barrel ($2\frac{1}{2}$ bu.) of apples @ 30¢ per peck?

337. A tank 5 ft. by 2 ft. by 1 ft. will contain about how many gallons of water?

338. Find the weight of the water.

339. Find the cost of 10 garden rakes @ 60¢ less 25%.

340. How many feet of lumber (board feet) in a board 18 in. wide and 10 ft. long? How much will it cost @ 6¢ per foot?

341. Draw an angle of 120° as nearly as you can estimate it.

It should equal how many right angles?

342. A field is 80 rd. long. How wide a strip of it will equal an acre?

343. If it were 4 rd. wide, how many acres would it contain? How many if it were 48 rd. wide?

344. In making concrete, 1 part cement (by measure) was mixed with 3 parts sand, and this mixture was mixed with an equal quantity of gravel. What part of the whole mixture was cement? What part sand?

345. Find the cost of 100 geographies @ \$1.25 less 20%.

346. If the north star is 42° above the horizon, how many degrees is it from the zenith?

347. On a scale of $\frac{1}{2}$ in. to 1 rd. draw a plan of a building lot $4\frac{1}{2}$ rd. by $6\frac{1}{4}$ rd., and divide it into square rods.

348. How many square rods does it contain?

349. Find the cost of 7 lb. 12 oz. of lobster @ 20¢.

350. If you were selling the lobster and received a 5-dollar bill in payment, what would you say in counting out the change?

351. In buying milk at the rate of 35¢ for a 2-gallon can and selling it @ 8¢ per quart, how much is the gross profit per can?

352. Find the interest of \$8 for 6 m. @ 4%.

353. Of \$27 for 9 m. Of \$60 for 3 m.

354. How many cords of wood in a pile 4 ft. by 4 ft. by 16 ft.?

355. How many in a pile 4 ft. by 4 ft. by 10 ft.?

356. How much will 48 arithmetics cost @ 30¢ less $16\frac{2}{3}$%?

357. How many quarts in $3\frac{1}{2}$ pk. of chestnuts?

358. How many glasses (half pints) of milk in 2 qt. 1 pt.?

359. A restaurant serves milk @ 5¢ a glass. How much does it get for a quart?

360. How much postage is required for a special delivery letter weighing 3 oz.?

361. $1\frac{3}{4}$ yd. $+$ $\frac{1}{3}$ yd. $= x$ yards

362. $1\frac{3}{4}$ yd. $\div$ $\frac{1}{3}$ yd. $= x$

363. Find the cost of insuring a house for \$2000 @ $\frac{3}{4}$%.

364. How many strips of board $2\frac{1}{4}$ in. wide can be sawed from a board 8 in. wide?

365. How many strips 2 in. wide can be sawed from a board 12 in. wide?

366. From a board 11 in. wide? From one 7 in. wide?

367. How many cord feet in a pile of wood 4 ft. by 4 ft. by $6\frac{1}{2}$ ft.?

368. How many cords in a pile 4 ft. by 4 ft. by 18 ft.?

369. Find the interest of $400 @ 4% for 9 m. For 1 yr. 6 m.

370. If a line 1 in. long represents 10 rd., how long a line will represent 1 mile?

371. How many bushels in 6 barrels each containing 10 pk.?

372. $83\frac{1}{3}\%$ of 60 min. $= x$ min.

373. A tank 2 ft. square and 1 ft. deep will hold how many cubic feet of water?

374. $2\frac{1}{2}$ in. $- \frac{7}{8}$ in. $= x$ $2\frac{1}{2}$ in. $\div \frac{7}{8}$ in. $= x$

375. Find the cost of 2 lb. 4 oz. of steak @ 35¢ a pound.

376. Find the interest on $1200 for 2 m. @ 6%.

377. Find the interest on $1200 for 8 m. @ 6%.

378. On $1200 for 1 yr. @ 6%.

379. Find the cost of 10 bicycles @ $30 less $33\frac{1}{3}\%$.

380. What part of a cord is a pile of wood 4 ft. by 4 ft. by 4 ft.?

381. What part of a cord is a pile 4 ft. by 2 ft. by 8 ft.?

382. How much is the postage on a registered letter weighing not more than an ounce?

383. What is the postage on a 10-ounce package of seeds sent 800 miles?

384. How much will 200 lb. of hay cost @ $18 per ton? How much will 100 lb. cost?

385. A boy earns 25¢ a day by taking care of hens. How much does he earn from March 1 to June 9?

Get the exact number of days.

386. Find the cost of 7 lb. 4 oz. of lamb @ 24¢.

387. Suppose a 5-dollar bill is given in payment. What would be good for the salesman to say in counting out the change?

388. Find the interest on $200 for 3 m. @ 4%. For 6 m. For 1 yr.

389. A tank 2 ft. by 4 ft. by 1 ft. will hold how many cubic feet of water? How many gallons?

1 cu. ft. = 7½ gal.

390. Find the cost of 2 lb. 2 oz. of mackerel @ 40¢.

391. A field 20 rd. by 4 rd. contains what part of an acre?

392. On a scale of ¼ in. to 1 rd., how long would a plan of this land be? How wide?

393. Find the cost of 1000 lb. of hay @ $16 per ton.

394. In buying cloth @ 37½¢ per yard and selling it at 50¢ the gain is how much per yard? What per cent of the cost?

395. Write decimally in position to add, $\frac{7}{100}$, $\frac{27}{100}$, $3\frac{13}{1000}$.

396. 62½% of 1 pk. = x quarts.

397. Find the cost of 10 qt. of peas @ 50¢ per peck.

398. When the moon is halfway from the horizon to the zenith (the point directly over head), how many degrees above the horizon is it? When it is ⅓ of the way to the zenith, how many degrees above the horizon is it?

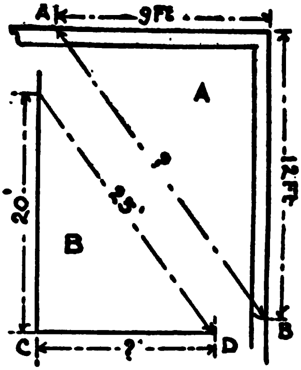
399. How much postage is required on a registered 15-ounce package containing a doll sent 90 miles?

400. How many rods of fence are required to inclose a lot of land 20 rd. wide and 30 rd. long?

401. A plumber leaves the shop at 8.30 to repair a water pipe, and returns at 11.15. At 60¢ an hour for the time he is gone from the shop, how much should he charge for the work?

402.* If the expense for tires on a large touring car averages 5¢ per mile, how much does it amount to on a 75-mile trip?

403. Through how many degrees does the minute-hand of a watch move in 5 minutes? In 25 minutes?



404. If the angle in diagram *A* is a right angle, how long is *AB?*

405. If the angle in *B* is a right angle, how long is *CD?*

406. Find the cost of 25 yd. of cloth @ 98¢.

407. How many rods in 12½% of a mile?

408. Find the circumference of a cylindrical tank 28 ft. in diameter.

409. If there is water 1 ft. deep in this tank, how many cubic feet of water does it contain?

410. A note for $200 with interest was dated Sept. 10, 1910, and $100 was paid Nov. 10, 1910. How much was the unpaid balance?

411. Find the cost of 3 lb. 9 oz. of steak @ 28¢.

412.* Two carts are used in carting loam. It takes one man 10 minutes to load a cart, and 5 minutes to drive it out, dump the load, and return. The wages for a man are the same as for a horse and cart. Is it cheaper to let each driver load his cart alone, or to employ a third man to help each in turn? How much cheaper?

413. How many days from Jan. 1 to March 1, 1911?

414. How many from March 10 to July 7?

415. Find the proceeds of 100 baskets of peaches sold at 75¢ on commission of 5% with freight charges of 15¢ per basket.

416. How many strips of carpeting 27 in. wide are required for a room 19 ft. wide?

417. How many feet in 6 boards, each 8 in. by 12 ft.?

418. Find the cost of these @ 8¢ a foot.

419. 87½% of 1 mile = x rods.

420. Find the proceeds of a note for \$400 for 30 d. discounted at a bank at date.

421. March 28 \$400 is deposited in a savings bank. How much is the amount of it Oct. 1?

422. How many square feet in the sides of a pyramid 12 ft. square with a slant height of 20 ft.?

423. How many cords in a pile of wood 4 ft. by 5 ft. by 32 ft.?

424. Find the cost of 600 lb. of hay at \$22 per ton.

425.* A tax of \$20,000 is to be raised on property valued at \$2,500,000. How much should be raised on each thousand dollars?

426.* How much on real estate valued at \$7000 and personal property valued at \$5000?

427.* How much on estate valued at \$8000?

428. Find the proceeds of a \$1000 bond sold at 110 by a broker on commission of $\frac{1}{4}\%$.

429. Find the cost of 50 third readers @ 50¢ less $16\frac{2}{3}\%$.

430. A salesman sells $\frac{7}{8}$ yd. of velvet @ \$6, and receives a 10-dollar bill in payment. What should he say in counting out the change?

431. Will a 27-foot mast lie upon the floor of a room 15 ft. by 20 ft.? How long is the longest mast which will lie upon it?

432. How much is the postage on a 2-pound package of seeds sent 900 miles?

433. Find the square of $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{7}$, $\frac{5}{7}$.

434. Find the square root of $\frac{4}{9}$, $\frac{1}{4}$, $\frac{9}{16}$, $\frac{25}{49}$, $\frac{9}{25}$.

435. How many acres in half of a quarter section of land?

436.* How long is the slant height of a hip roof in the form of a pyramid 32 ft. square and 12 ft. high?

437.* How many square feet in this roof?

438. Find the interest of \$200 for 9 m. @ 4%.

439. On \$40 for 8 m. @ 3%.

440. Find the cost of 2250 lb. of hay at $16 per ton.

441. I buy dry goods to the amount of $6.37, and give in payment 2 five-dollar bills. What should the dealer say in counting out the change?

442. To inclose a square field, 320 rd. of fence are required. How long is one side? How wide a strip of land along one side equals an acre? How many acres in the field?

443. How many acres in a lot 40 rd. by 60 rd.?

How wide a strip 40 rd. long equals an acre? How many such strips in the field?

444. Find the convex surface of a cone whose base is 21 ft. in diameter and whose slant height is 40 ft.

445. Find the interest of $12 for 1 yr. 4 m. at 6%.

446. What will $\frac{1}{2}$ ton of sugar cost at $.0625 per pound?

447. What will 5 bu. of nuts cost @ $3 less 5% for cash?

448. A man collects bills for me amounting to $640, and I pay him 12½%. How much do I realize?

449. Find the difference between $\frac{1}{2}$ of 20 and $20 \div \frac{1}{2}$.

450.* How many square rods in a lot $10\frac{3}{8}$ rd. long and $4\frac{1}{2}$ rd. wide?

451. How many half-pint mugs can be filled from $3\frac{5}{8}$ gal. of milk?

452. Estimate in inches the length of the lines on this page.

453. Estimate how many inches it is from the upper edge of the upper line to the lower edge of the lower line.

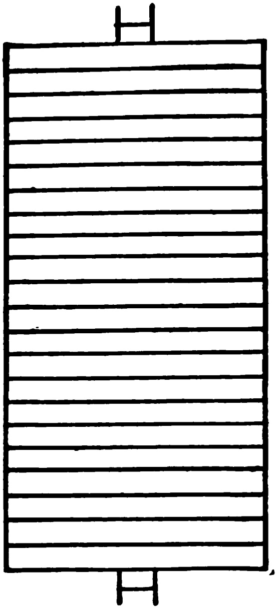
454.* Find the volume of a sphere 6 in. in diameter.

455.* Find the volume of a cone of the same diameter and 12 in. high.

456. On a map of Massachusetts Springfield measures $7\frac{1}{2}$ in. from Boston. If 1 in. on the map represents $11\frac{1}{4}$ mi., how far apart are these two cities represented?

457. March 28, $12 was deposited in a savings bank. When does interest begin? When is it added to the principal?

Drawing to Scale



458. The field of play for football is a **rectangle 300 ft. long and 160 ft. wide,** and is marked off on the ground by heavy white lines. On a scale of $\frac{1}{16}$ in. to 1 yd., how long a line will represent a side of the field?

459. How long a line will represent one end of the field?

460. Draw the **perimeter** of the field to this scale.

461. How many yards in half of the length of the field? Half of a **side-line** measures how many inches on your diagram?

462. Divide the field of play into halves by a line connecting the middle points of the side-lines.

463. The end-lines of the field are called the **goal-lines.** The field is marked off at intervals of 5 yd. by white lines on the ground parallel to the goal-lines. How far apart should these lines be drawn upon the diagram?

464. Draw these 5-yard lines.

465. Along one side-line mark the number of yards of each 5-yard line from the nearer goal-line.

466. There is a **goal in the middle of each goal-line.** It consists of **two upright posts** exceeding 20 ft. in height, and placed 18 ft. 6 in. apart, with a **horizontal cross-bar** 10 ft. from the ground. How many feet of the goal-line are not occupied by the goal? How many feet on each side of the goal?

467. Think of the goal-posts and cross-bar as having fallen outward from the field and lying in a horizontal position. Represent them in the diagram in this position.

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